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CONTENTS.

An Asterisk (*) denotes an illustrated article.

EDITORIALS—

Briefly Told 649

The Cowdery and Forstall Papers—The Philadelphia Natural Gas Company's Change of Base—Notes.

Eighteenth Annual Meeting, American Gas Light Association—Official Report—Revised by the Secretary.—Continued from page 620 650

First Day, Morning Session: Reading the Papers—The Mismanagement of Gas Works, by Mr E. G. Cowdery—Discussion—Committee on Place of Next Meeting—The Purification of Gas, by Mr. A. E. Forstall—Discussion.

Flue Gases from Steam Boiler and other Furnaces—Continued from page 622 656

On the Unburned Gases Contained in the Flue Gases from Gas Stoves and Different Burners 656

*Solid Machinist Vise 657

An Absurdity Revived 658

ITEMS OF INTEREST FROM VARIOUS LOCALITIES 659

Cooking by Gas, Los Angeles, Cal.—Cheaper Gas for Minneapolis, Minn—Public Lighting, Sioux Falls—The Oxy-Hydrogen Company, Wilmington, Del.—Sale of the Medina (N. Y.) Works—Improvements at Frostburg, Md.—Director Wagner's Estimates—Annual Meeting, Toronto—A Remonstrance against Arc Lighting, Yonkers, N. Y.—Passing the Dividend—How Manager Dyer Brought Uncle Sam to Terms—Large Belt—The Olean Authorities Surrender—Speculations by the Worcester *Spy*—The War at Murfreesboro, Tenn., Settled—Judge McConnell's Decision, Chicago Gas Trust Case—Accident at the Lynn (Mass.) Works—Odd Reasons for Decline in Chicago Gas Share Values—And Many Other Items.

The Market for Gas Securities 662

ENTERED AT THE POST OFFICE AT NEW YORK, N. Y. AS SECOND CLASS MATTER.

BRIEFLY TOLD.

THE COWDERY AND FORSTALL PAPERS.—In our current installment of the proceedings of the American Gas Light Association we give two very interesting and well prepared papers—the first by Mr. E. G. Cowdery, of Milwaukee, Wis., entitled "The Mismanagement of Gas Works;" the second by Mr. A. E. Forstall, of Chicago, on "The Purification of Gas"—which are all the more welcome because they are from authors neither of whom, if we remember accurately, had appealed to their fellow members for recognition as presenters of themes for set discussion at any prior meetings of the Association. But if they had not figured in such role before, each was well known to his fellows, Mr. Cowdery as the engineer of one of the best equipped and capably managed gas plants in the West, and Mr. Forstall, apart from his active connection with the gas industry, as the worthy son of a father whose fame and efficiency as an engineer will be admiringly treasured in the mirror of remembrance by his fellows of this and future days. Mr. Cowdery's paper would seem to be inaptly named, as was intimated by Mr. Littlehales, when the latter clever gentleman initiated the discussion on it with the remark that the title of "How to Manage a Gas Works Efficiently" would better express the text of the Milwaukee member's compilation. His suggestions as to the placing of responsibility for mistakes, in the office as well as in the works, are so sensibly sound that the wonder is that such suggestion is in any sense necessary; but we fear that in many of the larger plants the necessity for hints of the sort given will be found to apply with much force. Division of responsibility is all very well, but concentration of it is decidedly better, both for master and man. His paper is practical and valuable, and having read it one is forced to the conclusion that it is little wonder the Milwaukee Company is quite abreast of the times in respect to the best gas engineering practice of the day. One rather startling proposition made by Mr. Cowdery is in the thought that it might be possible to merge the handling of the residuals of many companies in one huge commercial undertaking. The idea is at once startling and novel, and while at first glance it would seem to be rather a complex undertaking, some measure of reflection dissipates a great cloud of the difficulties that appeared to stand in the way of the realization of the plan. As a paper writer Mr. Cowdery must be voted a success.

MR. FORSTALL'S paper on "The Purification of Gas," a theme that when discussed by his father some years ago, in the shape of a paper before the same Association, too, resulted in the making of great economies in the practice of purifying gas by means of lime, shows him to be a close student and further reveals the advances that have been made in this branch of gas manufacture as between the time of a generation. Perhaps the discussion brought this out more clearly, since Mr. Forstall dilated at greater length on the theory of rather than of the materials for gas purification; but in any event—and here we are indebted to Mr. Littlehales again—it was most gratifying to listen to the recital of plain facts, illustrated by truth-telling figures that, within the short space of six years, the charge against *material* for purifying the make of gas in a goodly-sized works had been reduced from 3.8 cents per 1,000 cubic feet to $\frac{5}{16}$ of a cent per 1,000, with the more than implied likelihood that

the gas was better purified in the latter period than in the earlier one. Oxide of iron has done much for our gas makers in the way of economy, and it promises to be a still better friend; for it is more than likely that the "dead mass" will soon be in demand, at good prices, for the contents that are locked within it, and which the chemist's key will readily release. Mr. Forstall's paper bears the impress of thought and the stamp of research, both blended harmoniously in the talent of a careful writer, and he is to be congratulated on the effect that his words exerted.

THE PHILADELPHIA NATURAL GAS COMPANY'S CHANGE OF BASE.—The Philadelphia Natural Gas Company's determination, followed by an announcement that the order carrying out the determination would be issued at once, shutting off from the puddling furnaces of Pittsburgh a supply of gaseous fuel, has an interpretation other than that such action was prompted solely by a desire on the part of the Company to husband its failing supply of material. In fact we incline to the view that the Philadelphia Company, in its comparatively brief, albeit dazzling business life, has determined that there is greater profit in retailing gas to ordinary consumers, for cooking and heating purposes, and receiving a fair return therefor, rather than to wholesaling the gas to manufacturers, who, apart from their inordinate drafts on the Company's mains, are disinclined to pay to it a rate per 1,000 even fairly commensurate with the true value of the material supplied. The Company's resolution has naturally caused much comment, and the technical papers were not slow to explain and criticise its action. About the best reference that has so far appeared to the matter was printed in a late issue of the *Iron Age* which says: "The action of the Philadelphia Natural Gas Company, of Pittsburgh, in cutting off the supply of gas to the puddling furnaces in a number of mills in that city has excited considerable comment. Predictions are being made on all sides that the supply is failing rapidly and will soon be exhausted, and that this is the beginning of the end of the fuel whose discovery and use had been the wonder and admiration of the scientific world. We do not think that the facts in the case will bear out these predictions. It is a well-known fact that the supply of natural gas has decreased to some extent, but not so largely as is generally supposed. It is also admitted that at some time in the future the supply will be exhausted. In the face of these facts, it is only natural that those persons who have invested largely in the development of natural gas territory should desire to sell the product at the highest price that can be obtained for it. When the use of natural gas as fuel was being introduced, contracts for its supply to manufacturers and private consumers were made at very low figures, in some cases at less than one-half the price that was paid for coal. There was no restriction whatever as to its use, and meters for the measurement of gas were not required by the companies nor asked for by the consumer. The result of this policy has been a reckless waste of gas in every direction by the consumer. In order to overcome this waste, meters were introduced and are now in general use, except in manufacturing plants, where the practice of contracting for gas at so much per annum is in force. Notwithstanding the attempt of the companies to curtail the quantity of gas consumed as much as possible, and still give the consumer all the gas needed, it has been found impossible to prevent shortages, and for this reason the supply has been cut off from a large number of puddling furnaces, where the waste is said to be very heavy, and from which the smallest income is derived. The price to private consumers has been increased 50 per cent., and the various companies intimate that in the future the interests of the private consumer will be taken care of, while the mills will get only what surplus gas may remain. While the manufacturers have been put to great inconvenience and considerable expense to alter their furnaces for the use of coal, it is possible that some arrangement will be made by which they will again be supplied with gas. For the present, at least, they will have to operate their furnaces with coal." It seems to us that the Philadelphia Company is, in this decision to cater to the wants of its private consumers, on the right tack, in that it is the profitable and safe one.

NOTES.—At the annual meeting of the Aurora (Ills.) Gas Company the following officers were chosen: President, I. B. Copley; Vice-President, T. H. Day; Secretary, E. W. Trask; Treasurer and Manager, I. C. Copley; Executive Committee, Senator Evans and Messrs. T. H. Day and I. C. Copley.——The Rockville (Conn.) Gas Company will put up a new gasholder on Maple street.——Mr. Benjamin Franklin Sherman died at his home in this city on October 28th.——The Boston Board of Health asserts that the Dorchester Bay works of the Bay State Gas Company are not carried on with due regard to the health and comfort of the residents of the neighborhood.——The projectors of the gas works for Palmer, Mass., are, under their charter, obliged to supply gas on or before October 22, 1891—one year from the granting of the ordinance.

[Continued from page 620.]

[OFFICIAL REPORT—REVISED BY THE SECRETARY.]

EIGHTEENTH ANNUAL MEETING OF THE AMERICAN GAS LIGHT ASSOCIATION.

HELD AT SAVANNAH, GA., OCTOBER 15, 16 AND 17, 1890.

FIRST DAY—MORNING SESSION.—OCTOBER 15.

READING THE PAPERS.

Current routine business having been disposed of, the President introduced Mr. E. G. Cowdery, of Milwaukee, Wis., who read a paper entitled—

THE MISMANAGEMENT OF GAS WORKS.

There has recently been expressed some difference of opinion as to the cause of the wonderful success achieved within the past few years among gas companies. Formerly it was thought impossible to make gas as cheaply as it is now sold. Such advancement has been made, however, within a comparatively short time, and right in the face of the advancement of electricity as a lighting agent, and right at a time when the outside public expected to see us lose ground, if not become extinct altogether. Why is this so? How has it been accomplished? This question has caused many to consider; and while some have given the credit of accomplishing such a result to good, sound, business management, others have considered that our companies, if not our works, were not yet conducted upon such a basis. It would not be consistent in me to assert which of the above interpretations is right. Individually, I do not believe the cause can be attributed wholly to good management. It has been very largely brought about by the condition of the times—fortunate conditions, which have given the business a lift in spite of itself. No doubt the advancement has been helped by business methods, which if not altogether good, have shown such a marked improvement over those immediately preceding that they have seemed to many remarkably good. At the same time there is no doubt but that the business and progress in it is, and has been, greatly retarded by methods which are not sound in principle, but greatly speculative in their nature.

In the management of our works great improvements have been achieved within the past few years, and at the present day, while there are very many things practiced by managers which are far from right, yet, among the majority, I believe, the management is good. Whether or not this summary of the situation is correct, the argument of the question will call for a very complete analysis. My present effort will be devoted, not to making any positive argument upon either side of this question, but simply to open the subject by bringing to your notice such points of mismanagement as have come to my notice. It is to be hoped that this Association will feel such interest in this subject that it will take it up with the earnestness that has characterized it with other subjects which always developed a great deal of good.

I do not mean to convey to you, at the outset, that our methods are all wrong at present; but that the combined thought and efforts of this Association cannot help but cause a decided improvement in any line to which it devotes its attention. To criticise the management, as carried out in different places, will lead to our selecting the best points developed, and, certainly, to bettering our methods. It is quite difficult to make a distinction between conducting the affairs of a gas company and those of a gas works, as they are ordinarily carried out. With a great many companies, and, I venture to say, with a majority, it would be hard to locate the responsibility for any mistakes; for such a responsibility is assumed in part by so many different officers, and not at all by any of them. To accomplish anything there is but one right way. To manage the affairs of any corporation there is but one right way, and that is to have a head to it. Such head I assume to be the manager, and such manager would of course, manage all the affairs of the corporation. With a gas company it is particularly so. Somebody must assume responsibilities which interweave themselves one within the other in such a manner that if divided between two or more parties, they can find so many opportunities to operate one against the other and shirk the responsibility that it would be difficult to obtain the best results. If the management place one man at the head of the works, another at the head of the street department, another at the head of the meter department, all without a practical man over them, each supreme in his own department, then who assumes the responsibility for leakage? Who assumes the responsibility of satisfying the consumer? Who is responsible for the financial success of the company? It is within the power of any one of the above departments to be very detrimental to the success of the company, and in such a way that it would be difficult to fix the responsibility.

It seems the proper way to overcome this difficulty and give the best management, to have at the head of the company a practical man acting as manager, and to have such manager capable of assuming all responsibility. It may seem to some of you that the above comes rather more under the head of the management of gas companies; but it is introduced into this article to show that the manager of a works having exclusively the works to look after, cannot do justice to himself or the company.

Again, the fixing, shaping, and following of the policy of management is one of the very important points needing our attention. It involves, of course, the policy of the company; but it must also involve the policy to be carried out in the works. If such policy be a proper one, it will be that the public shall be served as the merchant serves his customer when seeking to make a name and a business, while engaged in excessive competition. That is, they shall be served with the best possible article at the least possible cost. A gas company should follow this same principle, only making such profits as will return them a dividend on their capital such as the times will admit of or demand.

I do not mean, of course, that they shall do else than to lay aside a sufficient amount of surplus to cover depreciation.

A company should have everything that is right and fair for them to have; but everything in excess of this is due the public to have the benefit of.

A semi-public corporation, such as a gas company, owe this much to the public, and when they honestly serve them under such a policy, they may look for public appreciation. In these days of corruption they would be as sure to get it as the night is to come, and would be assured of a long and profitable life with a fair return upon their money always. How much better would such an investment be than one returning immense profits one year and a little or none for several years following.

It has been mentioned above that the true policy is to furnish the best possible article. It is but recently that managers have come to realize that because a 16-c. p. gas was considered good at one time, it could not always be so considered. It is quite true that among gas engineers there lurks a tendency to stick to existing and well known methods. It may not be more so than among others in other lines of business, but it is noticeable in our line. While the man should not be too enthusiastic over any new idea which his conservative judgment considers to be of merit he should give such new idea due consideration. If the public pronounce the incandescent electric light superior to gas light, what is the use of devoting our every effort to arguing them out of it; better devote our efforts to making the gas light of such quality that they cannot help but see the difference.

Within the past 15 years, gas companies have realized the necessity of reducing the cost of light to the consumer; they have, consequently, realized the necessity of studying economy, and have kept up a continual warfare against careless and extravagant methods until they have accomplished wonders.

The cost is now where they can afford to, and the times demand that they shall, supply a better light.

Let them now apply their energies in this direction.

The best managed companies to-day are those that supply their works with such apparatus as will produce the very best and strongest light. The days of 16-candle power gas are rapidly going by, and he that quickest makes up his mind to this will profit most by so doing.

We shall find plenty of opportunities to criticise the management of the works more directly as we enter the works.

What kind of management would you call it where the responsible officer cannot tell you the cost of his gas in detail? Where, because some item costs more than his neighbor, he cannot tell you why? What kind of management is it that keeps no record of all this detail? What kind of management is it that has no system to work under, but works from hand to mouth as each day's necessities are presented? What kind of management is it that will stick to old methods and customs and appliances until every one else has discarded them, for fear the newer would not be so greatly a decided success, when, by a little investigation and the exercise of a little judgment, it should know the new was superior to the old? There is no question of how you will answer the above queries. You all know these methods are the foundation of mismanagement; it is not necessary to dwell upon it. The best management will look after every detail in the works, will know its cost each month, and will know and carry out the possibility to do better. It is not necessary that the best management will always make the best gas the cheapest, but that it shall make the most of the advantages in its particular locality.

The cost of material, the value of residuals, the wages that labor demands, is different in different places, all the circumstances are different, perhaps, and it would be extremely unfair to judge of the management by the cost of the product.

The cost is also greatly influenced by the arrangement and location of the works. Above all, to obtain the best results, to make good management show its best in the returns, the works should be properly built and arranged.

The mistake of adding here and there, of modifying portions of old works, etc., has been, and is to-day, frequently made. Many times a comparatively small amount of additional money would have allowed one to make the improvements of a more permanent character; but the necessity of satisfying directors by the very smallest expenditure has prevented. It is a great mistake in management to let a small amount of additional capital stand in the way of completing a works and putting it in shape to produce the best known results. In such arranging and building, one should provide for every probable emergency. Too often, again, is the desire shown to save in the first cost by omitting necessary portions of apparatus.

To call your attention to a works supplying a city of 8,000 to 10,000 people absolutely with no other means of producing gas than a single water gas cupola, will seem to you absurd on the part of any management; but such a works is in operation, and doubtless there are many equally absurd methods practiced in other places. In many cases the management may mean well enough, but such unwarranted risks should never be carried for a single day. To rank with the well managed the works should be kept in good repair.

It is significant of poor management when the works is let run down through a desire to devote every cent to make a showing upon the yearly returns. The only reasonable excuse the management can make for such an action is that they really cannot afford it. In a season of sunshine prepare for a storm; so in seasons of prosperity in business, make preparations for the fruitless years.

We cannot do this better than by keeping our works in good repair; then, when misfortune overtakes us and it is necessary, we can discontinue our repairs for a year or two without seriously menacing the condition of our works.

Another mistake very common at the present day is the tendency among managers to force gas upon the consumers by excessive pressure.

Managers are ambitious to keep up their increase in consumption, not only because it is a nice thing to talk about, but it helps in reducing the cost of each 1,000 feet made.

As electricity has a tendency in some cases to take away the gas consumer, and, again, the reduction in the selling price has a tendency to reduce the income, the manager cannot wholly restrain his inclination to make the public shoulder the loss.

Such a proceeding is wholly unwarranted and should never be practiced; rather make the consumer's bill as light as practicable, than to force him to consume a large amount.

If we are looking for all the errors of management, we must find those that are introducing an excess of air into the composition of gas. We all believe the least possible portion of air is an injury. We know that an amount exceeding 1 per cent. is very injurious and quickly noticeable.

Any excess of air stratifies in the holder and settles to the bottom, if the holder is at rest and undisturbed for two or three hours.

When gas is turned on the street, from such holder, the effect is a dull, red, heavy-looking light, with very little luminosity. After a half hour or an hour, according to the quantity of air, this effect is lost and the gas appears all right. The general effect upon the public is even worse than an evenly poor gas, as it gives them the comparison and forces it to their notice. As stated before, we all believe this an injury, but, as is the case with most of us, the use of oxide purifiers requires the introduction of such air.

The mistake is made in carelessness in introducing it. The only safe and satisfactory way is to draw no vacuum with your exhauster, and thus preclude the possibility of introducing it in such a manner, but to inject the air back of the exhauster by means of a steam injector, or otherwise, always measuring the amount of air by drawing it through a meter. In no case let this amount of air be estimated, and in no case let it exceed 1 per cent. If your oxide purifiers do not act properly under this amount, get better oxide. Analyze your gas frequently for nitrogen, and if the amount of nitrogen exceeds 5 per cent., you may be sure you are introducing a surplus of air somewhere.

Many, I believe, either do not or will not believe their gas contains an excess of air; but an analysis would easily prove it to them. It is possible that the present management might be improved by giving the disposal of residuals more attention. In our Association this subject has been discussed, at length, at different times, with the result, no doubt, of increasing our energies and bettering results in this direction. We know these residuals are valuable, and we know that it is possible to greatly increase

our income from this source, if we could only find the proper way to do it. Our ammonia, in many cases, is disposed of at one-half what ought to be obtained for it. Coal tar has not, in years, brought anything like what it ought, until lately. In the West some companies are receiving $5 per barrel, and in Chicago it is retailing for $8. These prices are no doubt good, but perhaps not more than it is worth. Our spent oxide has to be thrown away, and, in many cases, we have to pay some one to take it away, when it ought to sell for enough to pay for its first cost, or even more.

To remedy this why should we wait for someone to invest his money to help us out? Why not follow the now well-established custom of combinations and trusts, and put all our residuals in one pot?

Have gas companies within a certain radius of some convenient center, through the managers of the contributing companies, elect a management to operate a plant for utilizing and disposing of all residuals. It would then pay to carry on an extensive works for this purpose.

Competition would be reduced to a minimum, and our companies would get the benefit of all that could be obtained from this source.

In the years previous to the formation of our conventions, managers, or those in control of the gas companies, did not acquaint themselves sufficiently with the operations of their neighboring companies. They visited each other, perhaps, but there had not grown up between them that open, free exchange of ideas and results that an association of men generates.

Consequently, progress in the profession did not begin to be made with anything like the rapidity that it has since.

Although very generally acknowledged now as necessary to the success of any company that its managing officers should attend these meetings to gain such information as they find it possible, yet, I believe, some companies do not yet recognize its importance. It is one of the most serious mistakes that can be made in the proper management of of any industry, to not give its manager every opportunity to learn, no matter how little, of that which will benefit it in the least.

Let us attend these meetings; make it our business to visit other works at least once a year; subscribe for and read every periodical bearing upon our business that time will permit, and be sure to make time for the most important. Let us not think, because we have visited a certain works once, we cannot learn anything by going again. That works is perhaps undergoing improvements, and may be working out ideas that have not occurred to us. If we follow these ideas we will not rank among those "mismanaging" gas works.

Thus far there have been numerated, probably, the most important of the ideas which should be brought to the notice of the management of our gas works. Attempt has not been made to criticise the management of the detail in operating a gas works. It seemed best to leave this for others to undertake. Much of this detail is a question of conditions and opinion, and I believe a number of equally well managed works might have as many methods of carrying out the details.

In general, those works that are properly arranged in the first place, where sufficient care is given to the quality, where machinery is introduced in every place where it will pay in that particular works, so that all the labor possible is dispensed with, where all the labor or the apparatus of the works is conducted under a proper system, where sufficient attention is given to the measurement of and to the condensation of the gas manufactured, where economy is practiced in all departments, and sufficient attention is given to the disposal of residuals—in such a place the works will be well managed let the detail be carried out as it will.

Discussion.

The President having temporarily vacated the chair, the chairman pro tem (Mr. A. E. Boardman) said: You have heard a very able and a very valuable paper from Mr. Cowdery. It is now open for discussion.

Mr. Littlehales—I have listened to the paper with a great deal of pleasure; but I think the title of it is somewhat misnamed. I think the title of it should have been, "How to Manage Gas Works Efficiently," instead of being the "Mismanagement of Gas Works." Of course, while the converse holds good, that a lack of those qualities which the writer of that paper has suggested means a mismanagement of the works, yet I would have liked to have had it more definitely pointed out where the particular items of mismanagement come in in gas works. Unfortunately a great many of those points are such that a practical manager cannot control; and a great many of those arise from the directorate, who look at the thing from one standpoint, while the practical manager who is responsible for the results has to look at things from a totally different standpoint. The directorate usually look at it from the shareholders' point, and never come in contact with the consumer; whereas for the whole result in the case of any failures, or in the case of the price of gas being kept too high, the man at the office has got to stand all the racket of it, and occasionally gets it in pretty liberal doses. The point in the paper about there being a unit of management I entirely agree with. I think that some man who comes in contact with the public, and who knows the whole ramifications of the business, should, as far as possible, have the whole control, certainly of the methods adopted and the policy carried out. Of course, so far as the management of the finances is concerned, that must be in the hands of the directorate. Another important point from my view, and which is perhaps the cause of a great many difficulties that arise in our business, is that works are often entrusted to the hands of men not at all trained in the gas business. Now, we know that it is within the ability of the average business man, if he has time enough, to learn the gas business the same as anything else; but in the meantime, while he is learning his business, the consumers are having to pay for that education. Mistakes are often made through a false economy; as perhaps thinking to save a little on the salary of a skilled man, the works are entrusted to an unskilled man, and the result is mismanagement—not an intentional mismanagement, but simply from a lack of experience that must produce mismanagement. And there is another point where I think mismanagement often arises. I think that every foreman should have charge of his own men—of the appointment of those men, and the discharging of them. I know that that is often done in the office; but my own experience has led me to adopt another rule, and I have found it to work very well. If you want a foreman, either in the works or of an outside department, to take a thorough interest in his work, he must have charge of his men; for he is often in a better position to tell which man is most efficient in his special work, or more apt, than the superintendent; and if he has the control due to his position, I think you would often find very much better results obtained. It gives the man a greater interest in his department, and more attention is paid to it. Now, if a man—a workman, we will say—is sent to the foreman from the office, it will often happen that the foreman has no control over him, and there is not as good a result obtained. I think that is one feature of mismanagement. I think it would be better policy from that standpoint if the practice were adopted of letting each foreman of a department have entire control so far as the employment of men is concerned. There is another point of mismanagement, especially in small gas works. We all know how important it is to have the retorts well set. In small works, perhaps in a majority of cases, some local bricklayer is employed to set the retorts. It would be better management to send two or three hundred miles for an experienced retort setter. You would save the extra expense in the wear and tear of retorts. I have often found it the case in small works that an average bricklayer, accustomed perhaps to throwing in joints half an inch thick, would be employed; but instead of there being any saving, the ultimate loss would be three times over the cost and expense of bringing a good man to do the work. That is one point of mismanagement, as it strikes me. Another point is in the lack of system in bringing in the meters regularly. Now, however good the meters you have may be to start with, where they are worked intermittently more or less of the number will get out of order and allow gas to pass. Some companies bring in their meters very regularly and systematically, and examine them frequently; other companies do not. I think these are like points of mismanagement where the actual items could be pointed out. My own experience is that you cannot bring in the meters, too often, within reasonable limits; and that there should be some regular system by which you will know when every meter has been brought in and overhauled. In many of these little ways, if a systematic course is pursued, we would get very much better results. Another thing that I was very glad to notice in the paper was the importance of giving prompt attention to all complaints. I have met with cases where (very much like what the President said in his remarks) there was a lack of attention even when customers went to the gas office. I entirely agree with those remarks. The first thing should be to let everything else stand and attend to those who come in. My instruction to our clerks always is never to let a man leave the door or the counter if it is possible to satisfy him in any shape or form. Whatever time is necessary to do that, even though it takes an hour of a clerk's time, should be taken. Employees sometimes hesitate to give that necessary time. My own experience is that no time is better spent by the clerks or in the manager's office than that which is spent in trying to satisfy customers by listening to their complaints and trying to remove the little difficulties. Often a call from the superintendent himself will straighten a difficulty out, for the customer feels that he is being treated well by reason of the mere courtesy that is shown him. I think these little matters must and will recommend themselves to every one of you,

and I think the man who will practice them will accomplish a great deal of good.

Mr. Somerville—One point of mismanagement which I think is worth dwelling upon is in the matter of distribution. We all bestow a great deal of attention to the making of our gas, to making the gas good, and to making the gas chemically pure; and then some lose from 10 to 15 per cent. of it in distribution. Now, that is what I call mismanagement. I do not know of a place where we can bestow attention with better results than in seeing that our mains are laid sound and tight, so that instead of losing the gas we may sell it to consumers. I have actually known of cases where the pipe laying has been let out to contractors at so much per foot; and the directors of the company thought they were doing a great thing, and making a splendid job, when they put a man to doing the main laying for about one cent per foot cheaper than it should cost them. They thought it was a good trade: but we know the result of that sort of thing. They put a pipe down, cover it over, and go on to the next; and then when the gas is turned in they find that it has to be done all over again, or if it is not done over again, it ought to be. This is a point that I would like to impress upon all—to look out for the main laying. Try not to lose a foot of gas if it is possible to avoid it. I hope the day is coming when this thing of leakage will be a thing of the past; that we will be able to direct our energies to getting sound and tight pipe that will retain the gas. There is some talk about wrought iron pipes, and I think it is a good idea. We want to do anything that will stop this leakage. It is wrong for us to have any such thing as leakage in these days. Mr. Littlehales' remark about meters is very good. Bring in the meters very often. Do not wait until they stop, but bring them in regularly and test them.

Mr. Lansden—I think this reference in the paper to pumping air into the mains may be, to outsiders, misleading to some extent. I hardly think Mr. Cowdery meant to describe the way that he introduced air into his gas, but to describe a method of revivifying the oxide, as I understand it. We all believe that the least possible portion of air in the gas is an injury. We all understand why he introduces a certain portion of air in the oxide in revivifying. I do not like to have it go out that gas companies are doing what they have been accused of doing for the last 25 years—pumping air into the gas—without having it appear why some of us who use a certain method of purification do introduce air to revivify the oxide; while others of us who use lime purification are still able to swear that we do not use any air.

The Chairman—I think it is very proper that the paper, and the remarks upon it, should be brought to the notice of our boards of directors, and that the paper will do much good in that way, as it will undoubtedly be brought to their attention by the engineers who are here present.

On motion of Mr. Egner the thanks of the Association were voted to Mr. Cowdery for his paper. President McMillin resumes the chair.

COMMITTEE ON PLACE OF NEXT MEETING.

The President—I think it would be well to name a committee to select a place for the next meeting of the Association before having the next paper read.

On motion of Mr. Greenough the President thereupon appointed the following gentlemen to serve as such committee: Messrs. John S. Bush, Isaac Battin, T. Littlehales, H. C. Adams, and Henry B. Leach.

Mr. A. E. Forstall, Chicago, Ills., here read his paper on

THE PURIFICATION OF GAS.

The manufacture of gas would be a very simple matter if the products of distillation came from the retorts or generators, in a fit condition to be passed directly through the station meter to the holder, ready for immediate distribution. Unfortunately this is not the case, the crude gas containing components that must be more or less completely eliminated before the goal of a salable article can be reached. Every operation to which the gas is subjected in its passage from retort to meter, has for an object the removal of one or more of these impurities, therefore all steps in gas manufacture, after the accomplishment of distillation, are properly included under the head of purification. They may be subdivided, according to the nature of their object, into two classes. First, those for the condensation of the heavy hydrocarbon vapors present in the highly heated crude gas, but which the same gas, at lower temperatures, is unable to hold in suspension; and, second, those for the removal of fixed gases, which are deleterious either in themselves or by reason of forming noxious compounds when burned. The first class, employing mechanical and physical means, friction and change of temperature, is known as the process of condensation, while the second, working by chemical reaction, comprises the operations of washing or scrubbing, and that final one to which in ordinary nomenclature is applied the name of purification, though it is really only a single step in the long series of purifying operations. Either on account of this arrogance of name, or because being an intermitted process it obtrudes itself more upon our notice than the others, which will, to a certain extent, run themselves. I think most of us commit the mistake of devoting extra energy to this branch of purification that might more profitably be given to condensation and scrubbing, and it is to these that I wish to call your attention.

The successful solution of any problem is dependent upon a clear comprehension of the object to be attained, and a knowledge derived from the properties of the substances to be acted upon, of the principles involved. In condensation, the objective point is the complete, harmless, and facile removal from the gas of those vapors, the deposition of which, inevitable under conditions certain to be met during its passage through the works and mains, will cause great annoyance, and damage the illuminating power of the gas, if not affected at the proper points and in the proper manner. At the same time, no hydrocarbons should be taken out, that the gas can be made to retain with advantage. Condensation is perfect only when the gas leaves the apparatus containing just enough hydrocarbon vapor to fully saturate it at the minimum of temperature and maximum of pressure to which it is to be subjected in the future. This, then, is the result to be sought, and the general principles to be followed for its attainment have been the subject of much experiment, by which the truth of the following seems to be well established. All heavy tar should be removed from the gas while it is quite hot, at any rate above 100° F. Contact between gas and heavy tar should be reduced to a minimum, and under no circumstances should the gas be allowed to bubble through tar. Contact between gas and the lighter tar or oils is not detrimental, and in some cases has seemed to be beneficial when occuring at moderately high temperature. Sudden chilling of the gas is to be avoided, especially during the last stages of condensation.

These principles necessitate the observance of the following points in constructing and arranging the apparatus. The hydraulic main should be so designed and taken care of as to preclude any possibility of the gas having to pass through tar, provision being made to keep the dips always sealed in liquor. The foul main, in which there is unavoidably more or less contact between gas and tar, should be so protected as to prevent any marked fall in the temperature of the gas while passing through it; and, if very long, the tar should be drawn off at several points, thus diminishing the length of contact. Some species of tar extractor should be placed before the condenser, to free the gas from all heavy tar before the final cooling begins, leaving only the lighter oils to be brought down at the lower temperatures. The reduction of temperature from the outlet of this extractor to the outlet of the condenser should be very gradual, the condensed liquids being drawn off at each stage of the process to prevent the contact between them and the gas as it cools, these oils possessing the property of absorbing, at the expense of the illuminating power, vapors that would otherwise remain in suspension. Atmospheric condensers are not as efficient as those using water, not being under as perfect control as the latter. The area of radiating surface should be large enough to permit the cooling to take place with a maximum difference of five degrees between the gas and water at any given point, and the smaller this difference the better will be the work done. With a properly designed condenser, the final temperature can be advantageously kept lower than is usually the case, though, of course, no benefit is to be derived from making it lower than the lowest temperature the gas will reach in its future progress.

These data have been established by observation and experience in handling coal gas, but there is no reason why they should not apply equally as well to carbureted water gas. Practically, the same mixture of hydrocarbon gases and vapors is under treatment, the tar formed when crude oil is used being almost identical with coal tar; so that methods of condensation proved to be the best in one case should also be best in the other. In most water gas works very little attention seems to be paid to condensation, the only care being to make it thorough enough to save trouble in the purifiers, and at the consumer's burner.

There has been no incentive to do more from the pecuniary point of view, as until lately the residual tar has had no market value, and the loss of illuminating power due to improper handling at this stage of the manufacture does not come home as a question of dollars and cents. However, as even ordinary coal gas, when improperly condensed, has only three-quarters of the theoretical candle power it might be made to possess by perfect treatment, and as the damaging effects of bad treatment increase rapidly as the gas becomes richer, it can easily be seen that the loss may be a very serious one. Up to the present, the increase in yield of candle-feet per gallon of oil, that has gradually been obtained since the introduction of illuminating water gas, has been almost

wholly due to improved methods and care in distilling the oil. But we have also a rich field for improvement in condensation, one that will well repay time and money spent in its development. Combined effort along both lines, distillation and condensation, may change the present ideas as to the illuminating value of a gallon of oil very materially.

However, whether treating coal or water gas, it is not sufficient that the apparatus should be improved in construction and arrangement. The most perfect apparatus will not take care of itself, and good results depend upon continuous, careful vigilance. Thermometers and pressure gauges should be placed wherever it is important to know what is taking place. Especially is this the case with the condenser, where a knowledge of the temperatures of both water and gas is absolutely necessary for intelligent working. Having provided the instruments, it should be made the duty of some particular person to read their indications at regular intervals, and adjust the water supply accordingly, with reference, not only to initial and final temperatures, but also to the regular and gradual decrease from one to the other, and the comparative temperatures of gas and water. With a properly constructed condenser this can be very easily done. A record should be kept of the average daily temperatures along the whole line of the condensing plant, which should be as carefully looked over and studied by the manager as is the record of any other operation involved in gas manufacture. Just as much attention should be paid to securing the best possible gas from the products of distillation as is paid to increasing the volume of these products.

Having the gas properly condensed, it is now, in the case of coal gas, to be put through the washers or scrubbers. With water gas there is no analogous step, the so-called washers used being really tar extractors. The main object of this operation is the complete removal of the ammonia present in the gas, but it must not be supposed that this is all that is to be done. There can be no greater mistake. The real problem is the removal of the ammonia in combination with as much of the carbonic acid and sulphureted hydrogen as it can be made to take up, thus reducing the work of the purifiers to a corresponding extent. When oxide of iron is the sole purifying material used, it is most important to saturate the ammonia with carbonic acid, and so increase the illuminating power. Unfortunately, however, there is no control over the relative amounts of carbonic acid and sulphureted hydrogen taken up, all that can be done being to make sure of the saturation by both acids, and preferably to form as far as possible those compounds in which one atom of ammonia unites with two of acid. As the carbonates and sulphides of ammonia are readily decomposed by heat, carbonic acid and sulphureted hydrogen being given off, it follows that the temperature should be kept low as possible during the scrubbing.

It is also advisable to use in the scrubbers the liquor from the hydraulic main and earlier stages of the condensation, as containing a large proportion of uncombined ammonia it will take up a corresponding amount of acid impurities. However, the scrubbing should be completed by the use of water free from ammonia, as in no other way can this be totally eliminated, and unless very cold water, or an immoderate quantity is used, the effect on the illuminating power will not be appreciable. The contact between gas and liquor must be made as complete as possible, and the time should not be cut too short. Here, also, records should be kept of the progress of the operations, samples of liquor being drawn off at various places and tested for contained ammonia and acids. Only in this way can we be certain of doing our best. Before there can be any hope of improvement in working, there must be an accurate and thorough knowledge of what is being done. Constant tests at all stages of the progress of the gas through the apparatus, are absolutely necessary for the attainment of the best results, and attention cannot be too often called to their value and importance.

I have confined myself strictly to outlining principles without any application of them to particular forms of apparatus, as I consider it of the first importance that we should have clear, well-defined ideas of what is to be done, and how it is best done, and also think that these can be better obtained by approaching the question from its theoretical side. When we begin to treat of special machines our prejudices and prepossessions are very apt to come into play, clouding our minds as to the real points at issue, but the true theory established, the application will follow as a matter of course. I have, therefore, endeavored to make plain the theoretical ends, towards which we are striving, with the theoretical lines along which our efforts should be directed to make these ends attainable, being confident that if I could succeed in fixing attention upon what ought to be done it would not take long for each one to put theory into practice, in the shape best suited to the conditions imposed by his own circumstances and surroundings.

NOTE.—On this subject, see The Report of the Council of the Gas Institute for 1883, in the Transactions for that year; also, vol. 41, page 1084, of *Journal of Gas Lighting*, etc.; The Chemical Theory of the Production of Illuminating Gas, by M. Gueguen, vols. 43, 44, and 45 Ibid; Some notes on Gas Liquor and Ammonia Purification, by Lewis T. Wright, Ibid, vol. 48, page 280; Condensation, by M. Alavoine, Ibid, vol. 48, page 65; also, Journal des Usines a Gaz, 1885, page 2,831; Condensation, M. Coze, Ibid, 1886, page 212; Lavage et Epuration du Gaz, Ibid, page 213; also, the Compte Rendus du Societe Technique du Gaz en France, for these years; Condensation, by R. B. Taber; Proceedings of American Gas Light Association for 1885–1886, page 202; also, AMERICAN GAS LIGHT JOURNAL, vol. 45, page 213.

Discussion.

The President—We will now discuss the points suggested in the very able paper which has been read in your hearing. I hope that modesty will not prevent any one from speaking.

Mr. Greenough—I do not want this paper to pass without expressing my appreciation of it. It is a very carefully thought out paper, and it is a great pleasure to have young Mr. Forstall read to us so good a paper as is his contribution to this special occasion. It shows the training that he has had, and the care with which that training has been applied. What he says about the condensation and purification of coal gas is, I think, substantially true; and I think that there is no portion of a gas company's business which is more frequently slighted. What Mr. Forstall says about the necessity of watching the temperature is most unquestionably correct; and yet I have in mind a visit paid not long ago to one of the largest, if not the largest, gas works in this country, and on my asking some question about temperature I was told that there was not a thermometer in the entire place—which is, in my judgment, as much as saying that the whole business of purification by that company was carried on absolutely without careful management from begining to end. I have nothing further to suggest than to express my appreciation of the paper.

Mr. Littlehales—I am sure that every member of this Association has a pleasant recollection of the name of Forstall in connection with the Association, and I can only say that the paper just read does credit to the name. I am sure if the ex-President of this Association could look and see what is going on he would experience a great amount of gratification to see his son following so ably in the footsteps of one whose memory shall always be cherished by us, and showing such excellent promise for the future. (Applause.) I agree with the paper, in the main. I would like to ask Mr. Forstall if he had come to any conclusion as to the relative importance, or the relative cost of lime or oxide, or of both combined? I have had some experience in the three methods; With lime alone, with oxide alone, and with lime and oxide together. I found some years ago in purifying that we were doing pretty fairly as we thought in purifying about from 5,000 to 6,000 feet per bushel of lime. Our boxes were very small in proportion to our make, and the gas was rushed through very rapidly. We put in a larger set of purifiers—very large as some would consider, in proportion to our make—and this enabled us to carry out the system which is generally adopted across the Atlantic, using the lime for the carbonic acid, and using the oxide for the sulphureted hydrogen. In the last year that we used lime exclusively our cost for purifying material was about $1,800, or equal to 3.8 cents per 1,000 feet made. The next year we had got in our oxide (and I may say that we used the natural oxide), and that year eight months were with lime alone, and four months with the oxide and lime in the manner indicated. We charged one-quarter of the cost of the oxide to that year, assuming that the oxide would last four years—we find that it will last very much longer than that; but we assumed that it would last four years, and consequently charge one-quarter of the cost. That reduced, for this year, our cost from 3.8 cents to 1.9 cents, or from $1,878. to $928. The next year, 1887, was the first year that we had fairly working and under way the new method of lime, first, and oxide, second; and our cost for that year, for 47,962,000 feet, was $285.70, or .6 of a cent per 1,000. In 1888, for 52,809,000 feet, the cost was .4 of a cent. The oxide did more work in the second year than it did in the first. We almost invariably find that with the native oxide, after it has been in once or twice it runs a longer period than it does the first time it is put in. Our cost that year was .4 of a cent. The next year the rate was the same. For the year ending January 31st, 1890, the cost of the purifying material was $182.05, which was .3 of a cent per 1,000 feet. For this current year, having only $167 still standing against the oxide account, it will cost us as near as I can estimate, for the few weeks remaining of our financial year, .2 of a cent per 1,000 feet. That is pretty low. It has this additional advantage,—that I am perfectly sure that the oxide will last two years more, and during that whole time it will cost

is absolutely nothing for material. We do not revivify it in the boxes, because while that is perfectly practicable, I find there is a tendency to a little caking of the oxide, and I find it does better to take it out occasionally than to revivify it in the boxes. If I did revivify it in the boxes I would never think of putting air in with the gas; but when the gas was turned off I would run a little steam and air through the boxes. I would never think of putting in the air with the gas for the sake of getting one-fifth of the oxygen out of the air, four-fifths of the nitrogen that is going off to dilute your gas—for that is where the trouble comes with the air process. I think you will not find many places where the purification has been done more successfully and cheaper than is shown by the figures I have given you. I have no doubt, as Mr. Forstall indicates, that the time will come when the oxide will be in such demand for making sulphuric acid and other sulphur products, that it will be worth just as much as the original cost after being used for purifying. There are many works in London that get their oxide supplied by the sulphuric acid makers, and taken away after use, free of cost, because of the sulphur which it contains. When they want to make pure sulphuric acid they usually get the sulphur from the sulphur mines of Sicily, and it costs probably $40 per ton. Now, an oxide can be run up until it contains from 45 to 55 per cent. of its weight of sulphur, in which case it should be worth half (or about one-half) the amount of sulphur. So you see that by-and-by, if a sufficient number of companies are purifying by the oxide methods, the same companies will no doubt be interested to recover the sulphur from the oxide, and then will make the oxide a merchantable article. I know that there is a great difference of opinion as to the relative merits of the natural oxide and the manufactured article. My own experience is altogether in favor of the native article. You have it distributed over large areas in the United States, and we also have it in Canada; and I am perfectly certain in my own experience that there is no comparison between the two results. I find that the quantity we have purified per bushel since we have had it in operation is something pretty large. I have here the figures of what we have passed through it, per bushel and per ton. During the whole of this year, from January 31st up to date, we have simply changed three boxes of lime and three boxes of oxide. That is rather a small number for nearly a year's work. For the whole year ending January 1890, we only changed four oxide boxes and six lime boxes. That is rather a small number.

Mr. Greenough—What is the size of your boxes?

Mr. Littlehales—The purifiers are 20 by 18 by 4½ feet. That is a point that I want to call the attention of the Association to. I think that there has been a tendency to unduly curtail the size of the boxes. I have been asked on several occasions with reference to small works that I was constructing or reconstructing, "What is your rule for calculating the size of the purifiers?" One simple rule is the financial ability of the company to build large ones, and that is the general rule that I pursue. I think very few of us realize, until we come to test the thing practically, what a difference in result there is when we work the boxes very slowly. It is almost impossible to purify the gas when it is pushed through rapidly. The purification of gas is necessarily a chemical operation—time is required to do it properly; and when the gas is rushed through rapidly there is no chance for it. I think the size of the boxes is a matter worthy of more attention from members than it has received. I do not attribute all of our success at Hamilton to the method, but partly to the very large size of the boxes, and I am sure the members will find that they will work more economically in every respect by having more liberal purifying space than is the usual rule.

Mr. Harper—I have listened with great attention and interest to Mr. Forstall's paper. He seeks to emphasize points which are very generally known here, but which are not by any means generally practiced. The subject that he has brought before us to-day is one of the greatest possible importance. I do not want to take up time in discussing it, but I would like especially to emphasize the importance of that part of his paper where he deals with the thermometer. I think that that point is of very great importance indeed. I shall be inclined to call that scientific practice as distinguished from scientific attainments. It is my impression that our business would make much more rapid progress than it has done if there were a more general idea of the chemical operations involved in the department of purification which Mr. Forstall has dealt with. It is evident to us all that here a greater or less knowledge of chemical operations is involved. It appears to me there is no business of the magnitude and importance of ours which has so little literature of a chemical nature as ours has. I think it is of very great importance that this literature should be obtained rather by experts in the profession than by someone outside of it. It seems to me that the words "gas analysis," or anything of that kind, are a pretty large stumbling block to the average gas manager; but it seems to me that a man does not require to be really an expert chemist in order to do a great many of the things that are necessary to be done in properly managed gas works. A great deal of that, as you are aware, is more or less of a mechanical operation than otherwise. I saw in a book not long ago published, in which a man sits down to address gas managers, the statement that "coke is a black, solid carbon;" and a few pages further on it speaks of a "standard acid," and there are similar phrases given as being things well known to chemists. It appears to me that that is the very thing that we do want to know, so that we may not have to presuppose. I think that a man might just as well sit down and tell us what he means by a standard acid, how it is prepared, what it is used for, and how used. And the same as to gas analysis. The analysis is simple; its operation is simple; and I think that we can understand what is meant by a "concentrated solution," and what is meant by a "moderate concentrated solution." I think that a man would derive a great amount of benefit from the information, and he would know that he was on the right track; and, therefore, I think that our business on the scientific side is one which, if properly developed, can be very rapidly advanced.

Mr. Littlehales—I have here the figures as to the amount of gas that we have purified by the oxide up to the 10th of October, 1890. We have purified, per ton of oxide, 4,857,700 feet, or, as the bushel weighs about 80 pounds, it is equivalent to 194,305 feet per bushel. That is the result at our works.

Mr. Slater, Jr.—To revert to that branch of purification of which the paper read by Mr. Forstall treated, I would like simply to call attention to one fact with regard to condensation, and that is—in most works, and in especially those of older construction, we find that the condensers are designed simply to cool the gas down to a certain temperature, apparently without regard to what happens in the gas during that process. In some works different varieties of coal are used, all put through the same process of cooling the gas, and various results are obtained which might be with proper attention to condensation changed; so that some coals which in certain works bear a very high reputation might be made to show very low results, and others that show very low with some few, might be made to show more uniformly with others. In connection with bad condensation there is another much mooted question which has been considered before the Association, and that is the question of naphthaline. I think it will be generally found that one of the most commonly recognizable causes of the formation of naphthaline would be the cooling, particularly the sudden cooling, of gas containing more or less moisture or water vapor. Where the condensation is done very rapidly, although the gas may be successfully cooled to 60°, if that is done very suddenly, and the gas contains much moisture on entering the condensers, the almost invariable result will be plenty of naphthaline in the condensers. But if the condensation is imperfect, and the gas is not cooled to a proper point, then of course the natural expectation would be to find naphthaline at such points in the progress of the gas where the temperature was reduced. I think that the point of slow condensation—not merely to reduce the temperature to a given degree, but to cool the gas very slowly—is a point that many of us would do well to consider.

The President—Will Mr. Scriver tell us about the oxygen process in Montreal?

Mr. Scriver—I have no information to give you with regard to the oxygen process, as we have not yet got it in operation. We are now constructing our works, and expect to be through with the construction in about three weeks. Down to the present time I cannot say anything about the effect that it is going to have upon our gas. We heard something about that last year. I think the information that we obtain in this way is very valuable; but at the present time we can add nothing to it.

The President—You may consider yourself booked for a paper on that subject at the next meeting.

Mr. Geggie—I think the point Mr. Forstall made, having in view the purification in closed vessels, is a very good one. I hope he will continue on in the good work until we get rid of lime, and oxide, and all these other things. I think also that his remarks on condensation are very correct. I think slow condensation is of great benefit to the gas. In my works I have two condensers, passing the gas first through an annular condenser, and then through a scrubber condenser. I do not have any naphthaline at all, and never had any stoppage because of it. I attribute its absence altogether to the slow condensation. I think if we would pay more attention to condensing the gas slowly, and quit rushing it through so rapidly, we should have no further trouble with naphthaline.

The President—I think there are many gentlemen here who would take pleasure in introducing you to the naphthaline. Are there any

further remarks? If no one else desires to speak, Mr. Forstall will reply to the remarks which have been made.

Mr. Forstall—I would like to ask Mr. Littlehales if the figures which he gave were for just the expense of the oxide.

Mr. Littlehales—For the purifying materials alone.

Mr. Forstall—Does that include lime, as well as both lime and oxide?

Mr. Littlehales—In all the figures given the cost of the purifying material was referred to, whether that was lime alone, or lime and oxide together.

Mr. Forstall—I have had no experience at all with the use of lime and oxide together. We used lime at first, and then we changed to all oxide. The figures for the oxide averaged with us about 1 cent. for labor, and 0.7 to 0.8 of a cent. for material. Of course, in the case of lime it was much greater. I think that Mr. Littlehales' results are largely due to the size of his boxes. We had at one time a new purifying house with a capacity of two million feet per day, and only passed 600,000 feet through it; and I did not have to change the purifying boxes more than once in three weeks, or once in a month. We started and worked it up to 1,800,000 feet, and then changed that same material in the boxes, sometimes every two days, and sometimes every day, so that the change was much greater in proportion to the amount of gas going through—changing much oftener than could be expected from the amount of gas passed. I want to express my thanks for the very kind remarks of Mr. Greenough and Mr. Littlehales.

Mr. Shelton—I think that we can do no less than to extend a very hearty vote of thanks to Mr. Forstall for not only a most instructive paper, but for an extremely well written paper. (Adopted.)

The President—Gentlemen, I want to return you my sincere thanks for the interest that has been manifested here this morning, for the order that has been kept, and for the system that all have observed in the discussions. If the members will all be kind enough to address the President, and wait for his recognition before they begin to speak, I think we will make better progress. That has been done this morning, and I hope it will be continued. On the second page of the printed programme I find in red ink this little paragraph: "Pay your annual dues at this time at the Secretary's desk in ante-room 104." The hour for adjournment having arrived, we will now take a recess until 2 o'clock.

[To be continued.]

[Concluded from page 622.]

Flue Gases from Steam Boiler and other Furnaces.

The following figures are taken from Mr. Longridge's report of 1887, to which reference has already been made. They have to do with the two experiments which are described at length in the report, and special attention seems to have been given to the question of the furnace gases.

The mean of four samples taken at intervals during the experiments with the five Lancashire boilers gives:

	Volumes.
Carbonic acid CO_2	10.35
" oxide CO	0.25
Oxygen O	7.98
Nitrogen and other gases N, etc.	81.42
Total	100.00

To determine the weight of each of these gases per pound of coal burnt, we first proceed to convert the volumes per cent. into weights thus:

	Volumes.	Relative Weights.	Weights Per Cent.
CO_2	10.35 × 22	227.7	15.20
CO	0.25 × 14	3.5	0.23
O	7.98 × 16	127.7	8.52
N	81.42 × 14	1139.9	76.05
Total		1498.8	100.00

We next require to know how much CO_2 and CO respectively were produced by the combustion of 1 pound of pure carbon under the existing conditions.

Now, 1 lb. of pure carbon requires for complete combustion $\frac{32}{12}=2.66$ lbs. of oxygen and produces $\frac{44}{12}=3.66$ lbs. of CO_2, whilst 1 lb. of carbon when burnt to CO, instead of CO_2, requires $\frac{16}{12}=1.33$ lbs. of oxygen, and produces $\frac{28}{12}=2.33$ lbs. of CO. Therefore, with the composition as in the above analysis, we shall have $\frac{15.2}{3.66}=4.146$ lbs. of carbon burnt to CO_2, and $\frac{0.23}{2.33}=0.0986$ lb. burnt to CO, or,

$$\left.\begin{array}{l}\text{Carbon burnt to } CO_2 = 0.9768\\ \text{" " } CO = 0.0232\end{array}\right\} \text{ Lb. for each pound of carbon burnt.}$$

But each pound of fuel burnt was found to contain only 0.655 lb. of pure carbon; therefore the weight of CO_2 and CO respectively per pound of coal burnt is:

CO_2, $0.655 \times 0.9768 \times 3.66 = 2.343$ lbs. (15.2 per cent. by weight.)
CO, $0.655 \times 0.0232 \times 2.33 = 0.0357$ lb. (0.23 per cent. by weight.)

From either of these figures we may calculate the total weight of dry gases per pound of coal burnt, thus:

$$CO_2\ \frac{2.343 \times 100}{15.2} = 15.4 \text{ lbs.},$$

or,

$$CO\ \frac{0.035 \times 100}{0.25} = 15.4 \text{ lbs.}$$

If in addition we know the quantity of available hydrogen in the coal—*i.e.*, the hydrogen over and above that required to form water with the oxygen present, we can determine how much water is produced in combustion, and thus arrive at the total weight of the products of combustion of 1 lb. of coal. In the case under notice the hydrogen was 0.0404 lb. in 1 lb. of coal, whilst the oxygen was 0.0809 lb.; the available hydrogen was therefore

$$0.0404 - \frac{0.0809}{8} = 0.0404 - 0\ 0101 = 0.0303 \text{ lb.},$$

which required $0.0303 \times 8 = 0.2424$ lb. of oxygen for combustion, and produced 0.2727 lb. of water. Adding this 0.2727 lb. of water to the 15.4 lb. of dry gases, we get 15.67 lbs. as the weight of the products of combustion, of which 0.655 lb. (C) + 0.0303 lb. (H) = 0.6853 lb. came from the coal, and the remainder 15.67 — 0.6853 = 14.98 lbs. came from the air supplied; therefore the dry air supplied per pound of coal burnt was 14.98 lbs. In his report Mr. Longridge adopts a more comprehensive method of calculation, and arrives at practically the same result as the above.

If we want to know what amount of heat is passing to waste into the chimney, we must know the temperature at which the gases leave the boiler on their way to the chimney. Then by multiplying the weight of each of the various gases by its specific heat and by the temperature of the issuing gases, we find the number of thermal units leaving the boiler. And if we deduct from this quantity the number of thermal units already in the coal and air when they entered the furnace, we shall know the actual amount of the loss sustained in this direction.

From the presence of a small amount of carbonic oxide (CO) in the samples analyzed, we learn that combustion was not complete, and it may be useful to ascertain what loss of heat this represents.

One pound of carbon when burnt to CO_2 evolves 14,544 thermal units, whilst one pound of carbon when burnt to CO only evolves 4,451 thermal units. As we have already seen, the amount of carbon in 1 lb. of the coal burnt was 0.655 lb., of which $0.655 \times 0.9768 = 0.64$ lb. was burned to CO_2, and the remainder, 0.015 lb., was burned to CO. Therefore the heat evolved in the production of

CO_2 = 0.64 lb. × 14,544 thermal units	9,308 thermal units.
CO = 0.015 lb. × 4,451 " "	67 " "
Total	9,375 thermal units.

But with complete combustion there would have been evolved 0.655 lb. × 14,544 thermal units = 9,526 thermal units. The loss is therefore 9,526 — 9,375 = 151 thermal units, or 1.6 per cent., and very plainly shows the ill effect of even so small a quantity as 0.25 volume per cent. of carbonic oxide in the flue gases.

On the Unburned Gases Contained in the Flue Gases from Gas Stoves and Different Burners.

In a paper read by William Thomson, F. R. S., F. C. S., at the Leeds meeting of the British Association the author said he had been working for some time with a view of determining whether the gases escaping as flue gases from gas stoves and different burners were really free from gas capable of combustion, such as carbon monoxide, or unburned hydrocarbons or hydrogen. He spent some time in trying to separate and determine the quantity of carbon monoxide present, if any; but as this problem was beset with so many difficulties for the moment he abandoned it, and contented himself for the present with determining the quantity of unburned carbon and hydrogen in whatever forms these might exist.

For this purpose he arranged an apparatus consisting of two carefully weighed U-tubes filled with strong sulphuric acid and weighed U-tubes

filled with soda lime, through which the flue gases were first passed. These absorbed the water and carbon dioxide contained in the flue gases, leaving the hydrocarbons (not absorbed by vitriol), hydrogen, and carbon monoxide to pass through a red-hot glass tube filled closely to the extent of 15 inches with oxide of copper prepared *in situ* from copper wire gauze. The gases were then passed through strong sulphuric acid and soda lime contained in previously weighed U-tubes, and the results were calculated on the gas, measured at 60° F. and 30 inches barometric pressure, from the measure of gas drawn into the aspirator (treated as water-saturated gas); the carbon dioxide and water vapor absorbed in the tubes being then added on, making up the measure of flue gas originally employed, and which was taken for the determination.

The coal gas employed was previously passed through large cylinders filled with calcium chloride to dry it before combustion, and at the same time as the experiment was going on, and side by side with it, was estimated the carbon dioxide and water vapor present in the air itself by passing it by means of another aspirator through strong sulphuric acid and soda lime in U-tubes previously weighed.

The carbon dioxide in the air itself ranged from 0.41 to 0.66 grain per cubic foot of air, and *the water* from 3.51 to 7.23 grains in the same volume.

The amounts of carbon dioxide and water collected from the flue gases, after deducting the quantities actually present in the air, were taken as those due to the combustion of the coal gas.

The standard employed was the one used by Professor Roberts Austen in his analysis of the flue gases from the burning of coal and the apparatus employed was generally similar to that also employed by him.

The carbon and hydrogen left unburned were measured in terms of 1,000 parts of carbon actually derived from the combustion of the gas in the stove or burner.

The total quantities of carbon dioxide and of water in the flue gases amounted to from 6.6 to 10.8 grains per cubic foot for the former, and from 5.6 to 10.5 grains of the latter in the same volume.

The amount of flue gas passed in each experiment was about 1 cubic foot, and although the variations were considerable, the general results conclusive in showing that the combustion of gas when burned in gas stoves for heating purposes is much more incomplete than one might be led to suppose.

The only burner in which the weight of the tubes remained constant after passing the burned gas, and in which the combustion was presumably complete, was in a paraffine oil lamp in which the flame was not turned to its highest point. In another experiment with the flame turned full on, 12.04 and 3.09 respectively of carbon and hydrogen escaped combustion per 1,000 of carbon completely burned.

The next nearest approach to complete combustion was in an Argand burner, in which all the carbon was completely burned; but an amount representing 0.2575 part of hydrogen escaped combustion per 1,000 parts of carbon completely burned, whilst in a second experiment 0.113 of carbon and 2.5414 of hydrogen escaping combustion were registered per 1,000 parts of carbon completely burned.

Then came one of Bray's ordinary flat-flame burners, burning 4 cubic feet per hour, which gave 11.12 of carbon and 0.95 hydrogen unburned per 1,000 of carbon completely burned.

Following in order these results came the Welsbach light, in which the gas heats to whiteness a tube or mantle composed of a filmy thickness of the oxides of zirconium and titanium, the mantle being surrounded by a glass tube similar to that used in some paraffin oil lamps. In this case the unburned carbon exceeded in amount the unburned hydrogen, there being 15.486 of the former and 3.794 of the latter per 1,000 of completely burned carbon.

Three experiments were made with a Marsh-Greenall's heating stove, in which three Bray's luminous burners were employed. The first was made with a consumption of 5.62 cubic feet of gas per hour, when 12.6 and 3 parts of carbon and hydrogen respectively were registered per 1,000 parts of carbon completely burned. The second experiment, with a consumption of 5.74 cubic feet per hour, gave 37.6 and 11.8 respectively of carbon and hydrogen unburned. The third experiment, with an increased consumption of gas (7.1 cubic feet per hour), gave 97.4 and 12.1 of carbon and hydrogen respectively unburned.

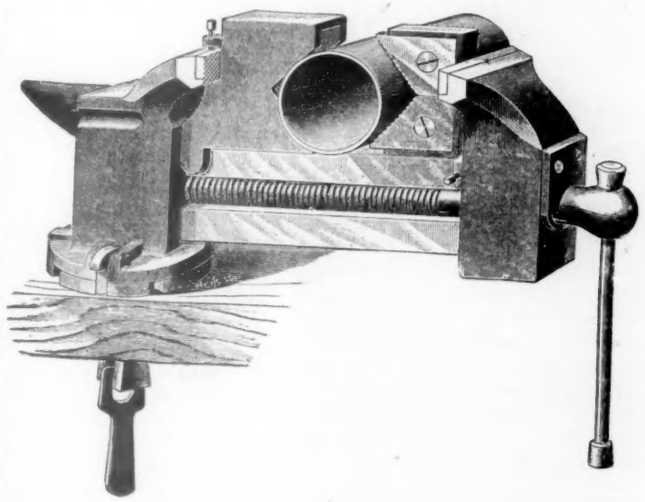
Two experiments were made with one of T. Fletcher's heating stoves, in which eight Bunsen burners play upon some fancy metal work (iron coated with magnetic oxide). The one experiment, in which the amount of gas passing was not measured, gave 43.3 of carbon and 24.6 of hydrogen unburned per 1,000 of carbon completely burned. In the second experiment, where 6.81 cubic feet of gas were burned per hour, 66.3 and 20 respectively of carbon and hydrogen unburned were registered.

One experiment was made with one of T. Fletcher's stoves, in which 20 Bunsen burners play on asbestos projecting from a fireclay back. With a consumption of 8.14 cubic feet of gas, 138.9 and 11.7 parts respectively of carbon and hydrogen per 1,000 parts of completely burned carbon were found.

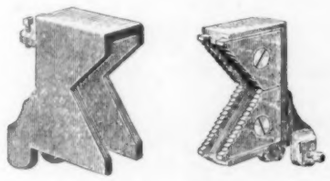
In a stove in which the hot gases rise to the top of a cylinder filled with pipes (through which cold air passes to be heated), and from the bottom of which the burned gases escape after having cooled to a considerable extent, upwards of 200 parts of carbon escaped combustion per 1,000 parts of carbon completely burned.

Solid Machinist Vise.

The Bonney Vise and Tool Works, Philadelphia, Pa., are putting on the market a line of solid machinist vises, as illustrated herewith. These include jewelers' and tool makers' vises, and are made with jaws from 3 to 6 inches in width. They have two heavy independent square steel bars, with a heavy square-thread steel screw passing through the center. This construction is designed to bring the resistance in the center of, and to divide the strain, and to prevent the jaws from twisting when work



is held out on the extreme end of the jaws, and also to prevent all jaw motion when used for heavy clipping. The bars are referred to as being firmly secured in the front jaw, and fitted in the back jaw, without a particle of lost motion; and being extra long, allow the vise to open wide. The jaws are designed for strength, and are unusually heavy, with a heavy steel face properly tempered. These vises all have a swivel base, with a lock attachment to adjust them to positions right or left, and it is stated are held as firmly as a stationary vise. The point is made that the steel bars being narrow allow all work that has to pass down



through the vise to be gripped close to the center of the jaws. A swivel attachment is provided, adapted for gripping taper pieces, which can be attached to the vise by placing the lower end in a hole provided for it in the upper bar directly below the movable jaw. Without this swivel attachment the result will be a parallel vise. By using the pipe attachment, Fig. 2, in combination with the bench vise, the result will be a pipe vise, as shown in Fig. 1. The pipe attachment, Fig. 2, is described as having the teeth in the jaw cut so as to enter the pipe at once on a direct pull, and not crush the top of the tooth. The manufacturers state that these vises are especially adapted for railroad, marine and large machine shops, where a solid, strong and durable vise is required.

MAYOR BRUSH, of Baltimore, has signed the agreement with the local Brush Electric Light Company, under which the latter is to maintain public electric arcs (2,000-candle power) at the rate of 35 cents each per night.

An Absurdity Revived.

Under this heading the London *Journal* makes the following remarks respecting the latest revival of the scheme to light London with gas made at the mouths of the coal pits:

It is, of course, understood by many people that the London County Council, as at present constituted, comprises a whole host of heaven-sent administrators, reformers and what not. If this impression is not universal throughout the entire body of owners and occupiers of the Metropolitan area, it is not owing to want of advertisement by members of the Council and their outside supporters. We continually hear boasts to the effect that what the Council actually does with the limited means permitted to it by a jealous government, is only an earnest of the things that will be done when the Council enters into its full inheritance of control of the police and of the ratable resources of the city and the rest of the province of London. Among other subjects to which the attention of this new administrative body is understood to be directed is the question of the abolition of London smoke. This is not quite such a pressing matter as several others which the Council has in hand; but it is nevertheless a serious question, and one that sooner or later must be looked into in a business like manner. Perhaps by the time the Council has settled the water supply upon a generally satisfactory basis, procured acceptance of the principle of "betterment" in regard to street improvements, completed all necessary transriverian communications, and established the rule of innocuous amusements for the Metropolitan population, we may know enough of the smoke question to be prepared with a warrantable remedy which shall only require legislative sanction to perform its appointed office. At present, notwithstanding all the well-meant efforts of the Smoke Abatement Institution, it cannot be truly said that the smoke question is yet ripe for the intervention of either Parliament or the County Council. In saying this, we do not mean to convey the idea that smoke-prevention laws and the methods of their application in the metropolis are all that could be desired. The fact is, of course, notoriously to the contrary. Smoke-prevention legislation is imperfect, and its execution is partial and unsatisfactory; and the Council would do a great deal of good if it could bring such legislation up to date, and ensure its strict application. Even if this were done, however, London would continue to be renowned for its manufacture of black fogs, which are the result of the outpourings of its innumerable house chimneys acting upon the cold mists arising from its river. While these agents for the production of black fogs remain untouched, the banishment from London of every factory, and the suppression of the smoke from every locomotive engine, river steamer, and industrial furnace, would leave the atmosphere of the metropolis much the same as it is now. The smoke question in London is a question of the domestic fire place and until we are prepared to grapple with these in a fashion the tyranny of which could only be excused by reference to its efficacy, the smoke problem in its gravity must be pronounced insoluble.

Meanwhile, it must be conceded that no progress will be possible towards the attainment of the desired object without the fullest discussion of every contribution to the elucidation of the subject. It is for this reason that we publish in another column the gist of an "open letter" written by Mr. T. Howell Williams, F. C. S., a member of the London County Council, to Mr. Walter Wren, another member of the Council, on the heating and lighting of London by pipe lines, with a view as the writer says, to "the abolition of London smoke, and the future prevention of London fog." This is to be done, according to the author's notion, by making at the coal fields two kinds of gas, for heating and lighting respectively, in conveying these gases to the metropolis, and distributing them, which he thinks could be done at such a figure that it would be "impossible in the future to burn coal economically in London." The latter expression not being very clear, Mr. Williams obligingly repeats it with the explanation that he means it would not pay to import coal, so that in London pieces of the "precious, but uncleanly mineral" would be tolerated as museum specimens. It will thus be noticed that Mr. William's programme does not fail in point of completeness. In making an end of London smoke, he means to make an end of its original and sustaining cause—the coal trade.

We do not give the first part of Mr. William's letter, which is devoted to the well-worn subject of the objectionableness of London smoke and fogs. All this may be taken for granted; and the repetition by Mr. Williams of the Londoner's case against fogs is pure waste of labor. Smoke-prevention enthusiasts are apt to lash themselves into a virtuous rage when declaiming against the evils of London smoke and the callousness of those who are apparently content to suffer from it. It has always appeared to us, however, that the attitude of passive endurance is really the only possible one under the circumstances, and that when people implore others to rebel against smoke or any other oppressor, it lies on them to show first that rebellion is hopeful as well as praiseworthy. This is the point where all smoke-preventive enthusiasts break down. They fail to persuade any sensible person that Londoners have, in respect to their fog trouble, any better course than to endure it. Perusal of Mr. Williams's counsels will show that he is no exception to the usual run of smoke preventionists, whose perception of the evil is out of all proportion with their powers of suggesting a remedy. We need not repeat Mr. Williams's proposal; it is only necessary to take note of the way in which he supports it.

He begins by arguing that his plan cannot be unscientific or impossible, because the late Sir W. Siemens once proposed to do something similar. Even Mr. Williams, however, rejects as absurd Sir W. Siemen's project for making coal gas actually in the pits; and he may therefore be open to conviction on the point that the scheme is not rendered more practicable even by the deprivation of this particular absurdity, and by assuming that the proper place for gas works is at the pit's mouth instead of it in the pit itself. For removing the retorts and furnaces, and the other paraphernalia of gas making, from the bowels of the earth to its surface, is merely avoiding certain very obvious disadvantages of construction and working. It entails sending the coal to bank, instead of carbonizing it at the bottom of the pit and sending up its products. The vertical distance to be travelled in this way by the coal or its products, however, is nothing to the horizontal distance which either must afterwards traverse before arriving at the point of consumption. Mr. Williams must therefore perceive that, leaving out for the moment all other considerations besides that of economy, it is simply a question whether it is better to carry raw coal or its products to the place where they will be converted into cash. At present we send the coal. It has to be proved that the other course would be more economical and otherwise preferable; and this is a task beyond Mr. William's powers.

The proposal is so exceedingly loose and vague that it is difficult to seize any particular argument advanced in its support, for the purpose of dealing with it critically. We suppose that the real question is the economical one; for Mr. Williams does not lay so much stress on the idea of the production of gas in or near London being a nuisance, as on the contention that if made on the coal fields and sent to town thence, it would be so much cheaper that people would naturally leave off burning coal. This assertion, however, he does not attempt to prove in any way whatever. Moreover, after the first statement of his proposal, he says no more about the fuel gas which he imagines as being sent to London alongside the illuminating gas. This is rather a pity, for we should like to learn from Mr. Williams, as a chemist, what he means by fuel gas, and where it is to be had as an article of commerce. He alludes to it as though it were as common a commodity as petroleum. But it is hardly fair in him to leave his readers in this belief; and we therefore take the opportunity of stating that there is no such thing as "fuel gas," specially made from coal, in common use anywhere in the whole world.

Then, upon what grounds does Mr. Williams believe that the illuminating coal gas, which is a reality, could be made on any coal field for half the cost of that actually sold in London? If he has any reason for making this astounding statement, he carefully conceals it. It is not quite clear whether he contemplates the summary extinction, without compensation, of all the Metropolitan and Suburban Gas Companies, so much of whose capital is represented by their works; but even the London County Council could hardly countenance this sort of thing, although it were proved that brand new works at the coal fields and high-pressure mains from there to London, would put gas into the town at something like one-half the current prices. Upon the wildest assumptions, however, this could not be proved to the satisfaction of anybody prepared to take due account of everything. In the first place, Mr. Williams is himself uncertain with regard to the location of the coal fields of which he speaks so glibly. He thinks that North or South Staffordshire or South Wales would do as the site of the gas works that should supply London; but he is happily oblivious of the considerations that might be held to militate against making the gas and fuel supply of the capital dependent upon one or two pipes considerably over a hundred miles long, and on the output of one or two pits in a certain coal field. He does not think of the cost of sending residuals to market, the difficulty of settling a colony of workmen, or, in short, of anything at all that a cautious person would have pondered over before launching such a preposterous scheme as this at the heads of members of the London County Council. When Sir W. Siemens first prattled about the idea before the British Association it was as much as could be endured by those who wished to retain some respect for the speaker's name and the company to which his idle words were addressed. What Sir W. Siemens could do without being laughed at too openly, people in the

position of Mr. Howell Williams, F.C.S., etc., cannot afford to copy. Eminent personages are permitted to talk nonsense occasionally; but this is a luxury not to be enjoyed with impunity by anybody under the grade of F.R.S. We always follow with care fresh contributions to the literature of the smoke question, because we recognize that the ultimate solution of this problem will be a matter of gas supply. But it is much to be regretted when a serious subject, as this of smoke abatement really is, is turned into ridicule by such crude guessers at the elucidation of the questions involved in it as we must conclude Mr. Williams to be from the evidence of his own words.

ITEMS OF INTEREST FROM VARIOUS LOCALITIES.

WE are indebted to a correspondent for the following, from Los Angeles, Cal., under date of October 24th: "In response to invitations issued by the Los Angeles Lighting Company some days ago, a large number of the members of the Los Angeles press availed themselves of the opportunity of partaking of a very fine dinner, prepared for the occasion on one of the Company's gas stoves, the banquet room being the hall of the Chamber of Commerce. Of course the dinner was given with the object of practically demonstrating what can be accomplished in the way of cooking by gas. Mr. T. W. de Buisey, a well known *chef*, had charge of the cooking. At 11 o'clock some 20 or more took seats at the table on the stage, when the following bill of fare was discussed:

Oysters, deep shell.
Green turtle soup.
Sacramento river salmon.
Potatoes, natural.
Young turkey, cranberry sauce.
Asparagus.
Lamb chops with green peas.
Fried bananas, strawberry glace.
Roman punch.
Mallard duck, currant jelly.
Lettuce salad.
Charlotte Russe, wine jelly.
Fancy cake, vanilla ice cream.
Bent's water wafers, Swiss cheese.
California fruits.
Cognac, black coffee.

"When the edibles had disappeared, through absorption, principally, Judge Marshall arose and proposed a toast to the Los Angeles Lighting Company, which was responded to in appropriate terms. The evening passed off most pleasantly, and General Manager Cline, of the Company, was on hand, here, there, and everywhere, looking out for the comfort of his guests. Unless I greatly mistake, the Chamber of Commerce dinner will boom the sale of gas ranges in Los Angeles this season.—A. T."

THE following notice to its consumers from the Minneapolis (Minn.) Gas Light Company explains itself: "The Minneapolis Gas Light Company announces that for all gas sold after January 1, 1891, the net price to the consumer will be upon the basis of $1.60 per 1,000 cubic feet. With the use of late improved atmospheric burners, and in the hands of an intelligent consumer, gas is not only the most satisfactory fuel for cooking purposes, but is equally as cheap as coal. For illumination no other light is equal to gas in point of quality or economy. Gas is now and will continue to be the cheapest and best illuminating agent. At these reduced prices, a gas burner producing a light superior to that from an incandescent electric lamp costs but 4 mills, or less than one-half cent per hour. With the use of regenerative lamps a 16 candle power light can be produced for less than one-fifth of a cent per hour."

THE authorities of Sioux Falls have ordered the local electric light company to keep the public arc lights (2,000-candle power) in service each night and all night, instead of on the moontable system heretofore in vogue there. The charge per arc under the new plan is $11.50 per month.

ADVICES from Wilmington, Del., dated October 28th, are to the effect that progress on the plant of the Oxy-Hydrogen Company is as follows: The holder is completed, and the boxes are being placed in the purifying house. The Hilles and Jones Company have been awarded the contract for furnishing the iron arch floor in generating house; and main laying is well under way. Despite all this seeming activity it is nevertheless close to the fact that the plant will not be in readiness to supply gas before next spring. It seems to us in reality to be a case of making haste slowly.

IT is said that Boston capitalists have secured the plant and franchises of the Medina (N. Y.) Gas Company, and that it is their intention to operate an electric lighting service in connection with the gas supply.

WE understand that an illuminating and fuel gas plant, with a capacity of 100,000 cubic feet per day, is being put up at Frostburg, Md., under the supervision of Mr. L. C. Parker. We hope to give further particulars, as to the process, etc., at an early day.

IT is on the cards that the Philadelphia Natural Gas Company is about to issue an order directing that hereafter no puddling furnaces in or about Pittsburgh shall receive a supply of natural gas for fuel. There are at least 1,000 such furnaces in the Pittsburgh district.

FOLLOWING this, it is hinted that the Philadelphia Company will go into the business of manufacturing artificial gas, the generating plant to be located in the gas coal district, the gas to be piped in all directions wherever the field seems profitable.

SEVERAL officials of Milwaukee (members of the Board of Aldermen and others) have planned a pleasure trip, with objective points at Jackson, Mich., South Chicago, Ills., and one or two other places, the object nominally being to investigate the manufacture and distribution of artificial fuel gas, with a view to determining whether Milwaukee could afford to take up the practice.

DIRECTOR WAGNER, in his estimate to the Philadelphia Councils Committee on Gas, says that he will require $2,998,000 to carry on the municipal gas works next year. He thinks that main extensions and replacements will absorb a half million dollars, and points out the pressing need that exists for a large distributing holder in the West Philadelphia district.

AT the annual meeting of the Consumers Gas Company, of Toronto, Canada, the following Directors were elected: James Austin, Samuel Alcorn, M. Baldwin, G. S. C. Bethune, Henry Cawthra, John Eastwood, J. C. Gilmor, George Gooderham, A. Lepper, James Scott, Dr. L. W. Smith, and Hon. Frank Smith. Mr. Austin was chosen President, and Dr. Smith was elected Vice-President.

THE following petition and remonstrance (signed by 33 residents on the line of and taxpayers in the district affected) was presented to the Common Council of Yonkers, N. Y., at the last meeting of that body in October:

To the Honorable, the Mayor and Board of Aldermen of the City of Yonkers: The undersigned, owners or occupants of property in the Third Ward of the city of Yonkers, respectfully protest against and object to the lighting of North Broadway and Palisades avenue, north of Ashburton avenue, by electric arc lights, and earnestly request that your honorable body will not authorize the erection of poles, the stringing of wires, or the placing of electric lights operated by a high tension current, in or along or over said streets. Your petitioners object to the introduction of such poles, wires, and lights in said streets, for the reason that such poles and wires cause an unsightly obstruction in the streets and necessitate the mutilation of the shade trees, which constitute one of the principal attractions in that part of the city. Further, because the stringing of wires carrying a high tension current in the vicinity of the telephone and telegraph wires which are connected with the houses of many of your petitioners, is a source of great danger both to life and property, rendering liable the burning of property and the destruction of life. Further, because the illumination produced by arc lights, at such distances apart as it is proposed to place them, is not sufficient to properly light the streets, and more particularly the sidewalks and the yards and fronts of houses, the light being too brilliant for comfort or convenience in the immediate vicinity of the lamp, and being insufficient for the greater part of the space between two lamps. The blinding light in the vicinity of the arc lamp suspended over the roadway is dangerous to both horses and their drivers, and the heavy shadows cast on the sidewalks, doorways, and courtyards make walking on the sidewalks or entering the houses dangerous, and moreover render it impossible to secure complete police supervision and protection.

AS was expected, the Secretary of the Laclede Gas Light Company has informed the shareholders that the regular dividends on the preferred shares will be passed. The notification took the form of a printed circular, in which the reasons set forth for the determination are that

the Company during the last twelvemonth expended something over $250,000 in new plant and on main extensions, and that in the near future the disbursements on other main extensions are sure to be large. The reasons ought certainly to be sufficient justification for the Directors' action, and the shareholders (although some of them seem decidedly put out over their failure to receive their dividend checks) have not much real reason for discontent; in that the preferred dividend is cumulative. It is merely a case of deferred payment. The market quotations did not vary greatly, as a result of the announcement, and at the close of the month $54 per share was freely bid.

PRESIDENT S. S. RUBIRA, of the Mobile (Ala.) Gas and Electric Light Company, has been enjoying a short holiday in this city. He looks well, feels well, and is quite enthusiastic over the Mobile lighting situation.

ON the evening of October 30th an alarm of fire brought the fire laddies out in force at the Commercial Point works of the Boston Gas Company, but their services were not sorely needed. Flames in a tar pot that vie'ded immediately to a handy tarpaulin, caused the alarm.

THE United States owed to the Salt Lake City (Utah) Gas Company the sum of $364 for gas consumed in one of the local public buildings during the period of April 1st and September 1st, and as is usual with the Government, the bills therefor were treated with neglect. Mr. Dyer, the Company's Manager, however, had full faith in Uncle Sam, and so waited without making impatient sign. Meanwhile the rent on Mr. Dyer's box in the post office became due, and, so it is said, proper notice of this fact was conveyed to Mr. Dyer. Whether or not, Mr. Dyer was considerably surprised at discovering that his mail was being delivered by hand, and the postman, on being appealed to, said that Manager Dyer's box had been "cut out of circuit" for non-payment of rent. And then it was that Dyer cut the gordian knot. Gas was cut off from the post office, and it remained "off" until the Government paid its bill to the last mill.

MESSRS. ROBIN & SADLER, of Montreal, have just completed for the Manitoba Gas and Electric Light Company, what they claim is the largest and heaviest belt ever made in Canada. It is 85 feet in length, 40 inches in width, and is made of three-ply leather. Each outer ply is a single width of 40 inches, and the center ply is of 20-inch strips,

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MR. WM. CURRIE will remain in charge of the works at Medina, N. Y., the recent sale of which to Boston capitalists is mentioned above.

THE Olean (N. Y.) Common Council has decided to make a compromise with the Keystone Gas Company, the proprietors of which resisted in the courts payment of taxes based on an assessed valuation of $100,000, a sum named some five years by the assessors as the taxable value of the Company's property. The Company claimed that a fair valuation of the property would be $31,000, and the difference was reconciled by agreeing on $50,000 as the final sum. During the five years that the case has been before the courts the city has collected taxes on the $100,000 basis, and as the valuation agreement is retroactive, the city will have to refund to the Company the sum of $2,488.

THE Worcester (Mass.) *Spy* recently said that it is by no means certain that the State Gas and Electric Light Commission will grant the petition of the Worcester Gas Light Company to consolidate with the local Electric Light Company, and then sapiently adds: "The members of the Commission are taking time to look into the matter, and it is not expected they will come to a decision at once." Certainly not, Mr. *Spy;* the Commissioners are not given to acting in haste so that they may repent at leisure. And we believe it is "reasonably certain" that the Commissioners' consent to consolidation will be obtained.

A BRANCH of the Peoples Non-Explosive and Sanitary Gas Company has been organized at Portland, Me., by certain parties who also have an interest in the same scheme at New Bedford. The officers of the Portland branch are: President, Francis C. Smith, of Cottage City, Mass.; Treasurer, Charles F. Bowker, of New Bedford.

THE City Illuminating Company, of Murfreesboro, Tenn., has absorbed the old Murfreesboro Gas Company, and the price of gas, which during the rate warfare was cut to $1 per 1,000, will be put back to a living figure. We believe that a controlling interest in the old Company was held by Mr. Carroll Collins, of the Green Bay (Wis.) Company.

THE following is the text of the decision of Judge McConnell in the case of Peabody vs. the Chicago Gas Trust:

"When the case was originally before this Court the main question put at issue by the petition and the pleas thereto was whether or not the respondent, by owning and controlling a majority of the capital stock of four gas companies doing business in the city of Chicago, had not established a monopoly of the business of manufacturing and selling gas in the city of Chicago, and for that reason should forfeit its charter or be prohibited from acquiring such power.

"The case now comes before this branch of the Circuit Court, and practically for the first time, upon a much broader question, and presented by the amended count and the respondent's pleas thereto. As the issues here stand, this Court must determine whether or not the respondent corporation can hold any shares of the capital stock of other gas companies.

"Whether or not the petitioner in this case is entitled to the judgment of ouster depends upon the construction of our statutory laws governing the organization of corporations, and incidentally upon the public policy which shall control the courts in determining and limiting the powers of corporations not expressly granted by the act of the General Assembly. The statute under which the respondent corporation was organized provides that except for the business of banking or insurance, real estate brokerage, the operation of railroads, and loaning money, any number of persons not less than three may form a corporation for any lawful purpose, and make a statement, duly acknowledged, setting forth the name of the corporation, the object for which it is to be formed, the amount of the capital stock, the number of shares, the location of the principal office, and filing such statement with the Secretary of State. It appears from the pleas filed by the respondent that the projectors in making a statement of its objects not only expressly stated that one of those was the manufacture and sale of gas, but also just as expressly and definitely stated that another of its objects was to purchase and hold or sell the capital stock, or purchase or hold or operate the property, plant, good will, rights and franchises of the gas works or gas company or companies, or any electric companies in the city of Chicago or elsewhere in Illinois.

"The corporation, it appears from the pleas, as has been before stated, has complied with all the provisions of the statute, and those pleas therefore must be held good unless the Court shall find that it was not organized for a lawful purpose, or that, conceding the purpose to be lawful, the corporation could not take, under the statute, the power of holding the shares of the other gas companies.

"The respondent contends that as its projectors expressed none but lawful purposes in their preliminary statement to the Secretary of State, that it has the power to prosecute all those purposes unless expressly restricted by other sections of the act, or by other legislation. This seems plausible. They strengthen their position by calling attention to the fact that the act authorizes the creation of corporations for any lawful purpose except banking, insurance, the operation of railroads, and loaning money.

"They say that the naming of these excepted business enterprises gives breadth to the objects for which corporations may be organized, and to the powers which are needful to promote and legalize those objects.

"But this position is not so strong when other sections of the act are examined. In section 5, corporations to be formed under the act are authorized to hold so much real and personal estate as may be necessary to the transaction of this business.

"The Legislature, when framing this act, evidently did not think that by section 1 corporations could exercise the power of holding real and personal estate, even for the purpose of carrying out the objects of their creation, or it would not have done a superfluous work of granting that power in another section. If section 5 had been omitted, then perhaps all the powers necessary to carry forward any lawful purpose would have been necessarily implied. But the grant of power in section 5 is as much a limitation as an endowment. Certainly, it cannot, however be plausibly argued from a grant of power to own, possess, and enjoy so much real and personal estate as may be necessary to the transaction of their business it can be implied that the statute gives to corporations power to own, possess, and enjoy property not necessary to the transaction of their business.

"But the respondent would contend in answer to this proposition: 'We do not claim the power to own, possess, and enjoy more personal estate than is necessary to the prosecution of our business as expressed in our statement and charter. We organized expressly for the purpose of buying and holding the capital stock of other gas companies, and therefore we are fully empowered by the grant in section 5 to own and

possess and enjoy such shares of stock as we buy as personal estate necessary to the transaction of our business.' This certainly is an answer, unless we carry back the language of section 5 and make a limitation of section 1, and if we do so, as I think we must, we reach the conclusion that a corporation cannot be organized under the act for the purpose or with power of holding personal estate not in use and not necessary to the prosecution of some business. I say I think we must come to this conclusion, when we take both sections into consideration, for the reason that it becomes apparent that the Legislature did not intend to authorize the creation of a corporation to have, own, possess, and enjoy personal estate independently of some other business enterprises, and then no more than necessary to the prosecution of that business. In other words, the statute does not authorize the aggregation of capital in corporate form and control for the purpose of mere investment, but only for the purpose of carrying forward some legitimate business enterprise. As before shown, the statute permits the organization of corporations for lawful purposes only.

"The respondent was organized for the following objects: To build, erect, purchase, lease, establish, maintain, enlarge, extend and operate works in the city of Chicago and in such other place or places in the State of Illinois for the manufacture, supply, sale and distribution of gas and electricity or either for the furnishing of light, heat, fuel and power for any and all purposes for which gas or electricity may now or hereafter be used. And to purchase and hold or sell the capital stock or purchase or loan or operate the property, plant, good will, rights and franchises, or any gas works or gas company or companies, or any electric company or electric companies in said city of Chicago, or elsewhere in the State of Illinois, and to purchase, hold, sell, operate, or in anywise become interested in coal or other properties productive of material necessary or useful in the supply or manufacture of gas or other agency or medium of light, heat, power or fuel, and to sell, improve, enlarge, extend, maintain, operate or devise any and all property so purchased or leased.

"Here is distinctly and boldly announced the purpose of absorbing in several different ways not only the property and plant and good will of other corporations engaged in the gas light and electric supply business throughout the entire State of Illinois, but also the franchises of corporations organized and under this act hereafter as they come into existence, and the franchises of companies organized before the passage of the act.

"The power claimed under the statement is one if exercised necessarily tending to the creation of a monopoly, and harmless only when not exercised at all. The purpose of participating in the management of other corporations by buying, holding, or selling the stock of other corporations is only in a degree less threatening to public interests than the entire ownership of the property and franchises of other corporations, and, if ingeniously employed, perhaps equally effective. Can it be supposed that the Legislature even contemplated that there should be organized a corporation endowed by it with power to acquire the property and franchises of all corporations formed under it or created upon its enactments? Could the Legislature have even contemplated a corporation endowed with power to participate in the management of many or all other corporations? If the respondent is right in its interpretation of the statute then the inquiries above made must be answered affirmatively.

"And if the respondent's interpretation is correct and it has assumed and exercised no more power than authorized by this statute, then it follows that a corporation may be expressely authorized to buy and use the 'rights and franchises' of any and all other corporations. And it follows again that a corporation organized under this statute may buy and use the rights and franchises of a corporation created before the act and with rights and franchises broader than the act confers. The contention, if accepted, carries us too far and away beyond the necessary reading of the statute and into a region of implication which all the rules of interpretation forbid us from entering, and particularly so when examining the powers and rights of corporations.

'A corporation,' said Chief Justice Marshall, 'being the mere creature of law possesses only those properties which the charter of its creation confers upon it either expressly or as incidental to its very existence.'

"I doubt if, in the history of corporations, there was ever a corporation endowed with powers as extraordinary and as far reaching as those assumed bv the projectors in this statement and now claimed by the respondent corporation.

"Again, the statute requires that in the preliminary statement the object for which the corporation is to be formed should be expressed. Can this requirement mean anything else than that some business object should be stated in order that the State and all persons dealing with the corporation should know what business the corporation prosposes to prosecute? There could have been no purpose in making this requirement, except that it should readily reveal information of the character suggested. Without meaning to say that I am governed by it in reaching a determination of this case, it suggests itself to me that while apparently stated in detail and at length, yet after all the objects expressed are so many as to be without the statute. In other words, I mean to say that I am inclined to be doubtful whether the Legislature, in authorizing the organization of a corporation for a lawful purpose, intended to or did authorize the creation of a corporation for many and entirely different purposes. Therefore, I reach the couclusion that the Legislature did not intend to authorize by this act the creation of a corporation to absorb or participate in the control of other corporations. I believe that if the statute did not clearly show that such power was not given a court would be obliged to declare such purpose unlawful. As before said, I believe the Legislature contemplated only the creation of corporations for the purpose of carrying forward some legitimate business enterprise.

"I believe the law to be settled that corporations do not take other powers than those expressly granted or springing by necessary implication from the power granted. I believe that the interests of government require that these creations of the government shall not take or exercise powers which do not come within the rule just announced.

"In the opinion of the Court the pleas not only do not answer the question, but confess a usurpation of powers. The demurrer to the pleas is therefore sustained."

City Attorney Allen, of Duluth, Minn., has brought a personal action against the Duluth Gas and Water Company to test the fact whether or not its charges are in excess of those permitted in its charter.

The authorities of Providence, R. I.) are considering the advisability (with every indication that they will sanction the change) of ordering the gas lamps kept in duty each night and all night. It is estimated that the additional annual expense of such service will not exceed $15,000.

The new owners of the gas works at Willimantic, Conn., as an earnest of their intention to improve the gas service of that city, are carrying out important betterments on the distribution system.

The huge flywheel on the Corliss engine that drives the machinery of the electric station of the Lynn (Mass.) Gas and Electric Light Company burst not long ago, and damage to the amount of $3,500 was occasioned. The light supply, however, was not seriously impeded, owing to the foresight that provided for the maintenance of a reserve engine.

The local papers, in accounting for the ragged quotations that have recently been made in Chicago gas shares, present very many curious theories. For instance, the Chicago *Herald*, of October 28, said: "In the present nervous condition of the market, holders of Chicago Gas Company stock are inclined to be panicky, and a statement that the Gas Light and Coke Company proposed to withdraw from the Trust led to a decline of 4 points in Chicago Gas Company certificates yesterday. Some of the reports sent out from New York make it the Peoples Gas Company which was about to withdraw instead of the Gas Light and Coke Company, but as a majority of the stock of both Companies is owned by the stockholders in the Chicago Gas Company, and deposited with the Fidelity Trust, of Philadelphia, in exchange for Chicago Gas Company certificates, it makes little difference which was used for panic purposes. The story was further ornamented with suggestions that the Chicago Gas Company was likely to be enjoined from the payment of further dividends, and that the two local Companies above named had agreed to pay no more of their earnings to the Fidelity Company as dividends on their stock held by the latter. Officials of the Chicago Gas Company here say they have no advices as to the former, and are equally uninformed as to the latter alleged proposition. President Billings said the quarterly dividend would be paid as announced, and Director Cummings said the only disagreements on the inside were those between the local Directors, who favored $1 gas, and the out of town Directors, who desired to maintain the present rate."

At a recent meeting of the Herkimer (N. Y.) Board of Trustees bids for the erection of a municipal electric lighting station were opened. The award was made to the Edison Company, which agreed to furnish the necessary apparatus for the maintenance of 40 arcs of 2,000-candle power each (to include the stringing of 7 miles of wire), for the sum of $6,600. The Edison Company claims that it will lose $2,000 by this contract, but is satisfied thereat, according to its agent, having determined "to secure the award at any figure, as there was no plant of the Edison type in the Mohawk Valley."

The hearing in the case of the Consumers vs. the Chelsea (Mass.) Gas Company for a reduction in gas rates has been declared closed by the Commissioners.

THE AMERICAN GAS LIGHT JOURNAL

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PROPRIETORS.

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AGENTS.

NEW YORK.—AMERICAN NEWS CO., 39 and 41 Chambers Street.
Germany.—B. WESTERMANN & CO., of New York.

MONDAY, NOVEMBER 10, 1890.

The Market for Gas Securities.

Election week and an uneasy money market caused a decline all round in the share dealings since the time of last writing, but those securities that were least affected were gas shares, save in respect to Chicago gas, which went off sharply on rumors and on fact. The decision of Judge McConnell in the latest phase of the Trust case will be found in full in our item columns, and a careful analysis of it seems to us to place the Company in no worse standing than before. Investors may depend upon it that the Chicago Company will eventually come out all right, and that the shares are decidedly cheap at current quotations. Consolidated to day (Friday) opened at 99, but the trading was light and spiritless. Brooklyn shares more than hold their own, despite the continued rumors of opposition. The Laclede Company will pass its dividend on the preferred shares, but as the shares are on the cumulative basis, the announcement did not cause much confusion. Bay State is somewhat weaker, and Consolidated, of Baltimore, is steady at 49½ to 50. The Boston *Advertiser* is authority for the statement that the Bay State Company will expend next spring $250,000 in enlarging the Commercial Point station, and that that enlargement will enable it to dispose of its real estate at the North End. Perhaps that would be good policy, but we are inclined to doubt it. The market at large is steady, with a good demand for approved gas bonds.

Gas Stocks.

Quotations by Geo. W. Close, Broker and Dealer in Gas Stocks,

16 WALL ST., NEW YORK CITY.

NOVEMBER 10.

☞ All communications will receive particular attention.
☞ The following quotations are based on the par value of $100 per share.

	Capital.	Par.	Bid	Asked
Consolidated	$35,430,000	100	99	—
Central	500,000	50	95	100
" Scrip	220,000	—	95	100
Equitable	4,000,000	100	125	127
" Bonds	1,000,000	—	113	115
Harlem, Bonds	170,000	—	—	—
Metropolitan, Bonds	658,000	—	110	115
Mutual	3,500,000	100	120	—
" Bonds	1,500,000	—	100	102
Municipal, Bonds	750,000		—	—
Northern		50	—	—
" Bonds	150,000	—	—	100
Standard Gas Co—				
Common Stock	5,000,000	100	38	42
Preferred	5,000,000	100	83	87
Yonkers		50	112	—
Richmond Co., S. I.	346,000	50	—	—
" Bonds	20,000	—	—	—
Gas Co's of Brooklyn.				
Brooklyn	2,000,000	25	120	123
Citizens	1,200,000	20	99½	100
" S. F. Bonds	320,000	1000	100	103
Fulton Municipal	3,000,000	100	133	135x
" Bonds	300,000		100	105
Peoples	1,000,000	10	90	93
" Bonds (7's)	368,000	—	100	—
" " (6's)	94,000	—	100	—
Metropolitan	1,000,000	100	108	111
Nassau	1,000,000	25	135	—
" Ctfs	700,000	1000	100	102
Williamsburgh	1,000,000	50	131	133
" Bonds	1,000,000	—	108	112
Out of Town Gas Companies.				
Boston United Gas Co.—				
1st Series S.F. Trust	7,000,000	1000	93	93½
2d " " "	3,000,000	1000	71	72
Bay State Gas Co.—				
Stock	5,000,000	50	63½	—
Income Bonds	2,000,000	1000	95½	—
Buffalo Mutual, N. Y.	750,000	100	90	95
" Bonds	200,000	1000	95	100
Citizens, Newark	1,000,000	50	155	160
" " Bonds	45,000	—	—	—
Chicago Gas Company.	25,000,000	100	38⅞	39
Chicago Gas Light & Coke Co.—				
G't'd Gold Bonds	7,650,000	1000	—	92½
Equitable Gas & Fuel Co., Chicago, Bonds	2,000,000	1000	—	98
People's Gas and Coke Co., Chicago—				
1st Mortgage	2,100,000	1000	—	100
2d "	2,500,000	1000	94	98½
Consumers Gas Light Co., Jersey City	2,000,000	100	—	30
Bonds	600,000	1000	80	—
Cincinnati G. & C. Co.	6,000,000	100	201	203
Consumers Toronto	1,000,000	50	190	200
Central, S. F., Cal			80	90
Capital, Sacramento, Cal			58	
Consolidated, Balt.	11,000,000	100	49½	50
" Bonds	6,400,000		107	107½

Advertisers Index.

GAS ENGINEERS. Page

Jos. R. Thomas, New York City ... 673
Wm. Henry White, New York City ... 679
Wm. Mooney, New York City ... 673
Fred. Bredel, N. Y. City ... 675

CHEMISTS.

Durand Woodman, New York City ... 668

GAS AND WATER PIPES.

Gloucester Iron Works, Phila., Pa ... 673
Mellert Foundry and Machine Co., Reading, Pa (John Fox, Selling Agent, N. Y.) ... 673
Ohio Pipe Co., Columbus, Ohio ... 673
M. J. Drummond, New York City ... 673
R. D. Wood & Co., Phila., Pa ... 678
Warren Foundry & Machine Co., New York City ... 673
Donaldson Iron Co., Emaus, Pa ... 673
Dennis Long & Company, Louisville, Ky ... 673
Spiral Weld Tube Company, New York City ... 673

PROCESSES.

National Gas Light and Fuel Co., Chicago, Ills ... 670
Bartlett, Hayward & Co., Baltimore, Md ... 677
United Gas Improvement Co., Phila., Pa ... 669
The American Gas, Light and Heat Co., Phila., Pa ... 663

GAS WORKS APPARATUS AND CONSTRUCTION.

James R. Floyd & Sons, New York City ... 679
Continental Iron Works, Greenpoint, L. I ... 679
Delly & Fowler, Phila., Pa ... 679
Kerr Murray Mfg. Co., Fort Wayne, Ind ... 676
Stacey Mfg. Co., Cincinnati, Ohio ... 679
Bartlett, Hayward & Co., Baltimore, Md ... 677
Morris, Tasker & Co., Limited, Phila., Pa ... 677
Davis & Farnum Mfg. Co., Waltham, Mass ... 676
R. D. Wood & Co., Phila., Pa ... 678
Bouton Foundry Co., Chicago, Ills ... 679
Isbell-Porter Company, New York City ... 678
Fred. Bredel, N. Y. City ... 675
United Gas Improvement Co., Phila., Pa ... 669
National Gas Light and Fuel Co., Chicago, Ills ... 670
Berlin Iron Bridge Company, East Berlin, Conn ... 698

INCLINED RETORTS.

Laclede Fire Brick Manuf'g Co., St. Louis, Mo ... 697

GASHOLDER TANKS.

W. C. Whyte, New York City ... 670
J. P. Whittier, Brooklyn, N. Y ... 671

GASHOLDER PAINT.

The Government Waterproof Paint Co., Boston, Mass ... 665

RETORTS AND FIREBRICK.

J. H. Gautier & Co., Jersey City, N. J ... 674
B. Kreischer & Sons, New York City ... 674
Adam Weber, New York City ... 674
Laclede Fire Brick Manuf'g Co., St. Louis, Mo ... 674
Brooklyn Retort and Fire Brick Works, Brooklyn, N. Y ... 674
Borgner & O'Brien, Phila., Pa ... 674
James Gardner, Jr., Pittsburgh, Pa ... 674
Henry Maurer & Son, New York City ... 675
Chicago Retort and Fire Brick Co., Chicago, Ills ... 674
Baltimore Retort and Fire Brick Co., Baltimore ... 674
Oakhill Gas Retort and Fire Brick Co., St. Louis, Mo ... 674
Boston Fire Brick Works, Boston, Mass ... 674

SCRUBBERS AND CONDENSERS.

G. Shepard Page, New York City ... 668
R. D. Wood & Co., Phila., Pa ... 678

REGENERATIVE FURNACES.

Bartlett, Hayward & Co., Baltimore, Md ... 677
Fred. Bredel, New York City ... 675
Chicago Retort and Firebrick Co., Chicago, Ills ... 674
J. H. Gautier & Co., Jersey City, N. J ... 675
Adam Weber, New York City ... 666

GAS GOVERNORS.

Connelly & Co., New York City ... 671
Fred. Bredel, N. Y. City ... 675
Friedrich Lux, London, England ... 666
Wilbraham Bros., Phila., Pa ... 671

SELF-SEALING MOUTHPIECE DOORS.

Ibsell-Porter Company, New York City ... 678
James R. Floyd & Sons, New York City ... 672

TAR AND CARBONIC ACID EXTRACTOR.

Geo. Shepard Page, N. Y. City ... 632

CEMENTS.

C. L. Gerould & Co., Brooklyn, N. Y ... 674

GAS ENRICHERS.

Standard Oil Co., Cleveland, Ohio ... 680

GAS METERS.

John J. Griffin & Co., Phila., Pa ... 682
American Meter Co., New York and Philadelphia ... 683
The Goodwin Gas Stove and Meter Co., Philadelphia, Pa ... 683
Helme & McIlhenny, Phila., Pa ... 683
D. McDonald & Co. Albany, N. Y ... 683
Nathaniel Tufts, Boston, Mass ... 682
Maryland Meter and Manufacturing Co., Baltimore, Md ... 663
Jones Meter and Stove Co., Royersford, Pa ... 682
Harris Bros. & Co., Philadelphia, Pa ... 682

EXHAUSTERS.

The P. H. & F. M. Roots Co., Connersville, Ind ... 664
Isbell-Porter Company, New York City ... 678
Wilbraham Bros., Philadelphia, Pa ... 671
Connelly & Co., New York City ... 671

GAS COALS.

Penn Gas Coal Co., Phila., Pa ... 681
Perkins & Co., New York City ... 680
Despard Coal Co., Baltimore, Md ... 681
Chesapeake and Ohio R. R. Coal Agency, N. Y. City ... 681
Westmoreland Coal Company, Phila., Pa ... 681
J. & W. Wood, New York City ... 680

CANNEL COALS.

Perkins & Co., New York City ... 680
J. & W. Wood, New York City ... 680

VALVES.

Ludlow Valve Manufacturing Co., Troy, N. Y. ... 661
John McLean, New York City ... 661
Chapman Valve Manufacturing Co., Boston, Mass ... 664
R. D. Wood & Co., Phila., Pa. ... 678
The P. H. & F. M. Roots Co., Connersville, Ind ... 628

GAS ENGINES.

Schleicher, Schumm & Co., Phila., Pa ... 648
Clerk Gas Engine Co , Phila., Pa. ... 681
Van Duzen Gas Engine Co., Cincinnati, Ohio ... 681

ENGINES AND BOILERS.

Jarvis Engineering Co., Boston, Mass ... 671

STEAM PUMPS.

Van Duzen & Tift, Cincinnati, Ohio ... 664

GAS LAMPS.

Welsbach Incandescent Gas Light Co., Phila., Pa ... 665
The Siemens-Lungren Company, Philadelphia, Pa ... 665
Fiske, Coleman & Company, Boston, Mass ... 674

PURIFIER SCREENS.

John Cabot, New York City ... 666
Bartlett, Hayward & Co., Baltimore, Md ... 666

GAS STOVES.

American Meter Co., New York and Philadelphia ... 607
The Goodwin Gas Stove and Meter Co., Phila. Pa ... 684
George M. Clark & Company, Chicago, Ills ... 666
D. McDonald & Co., Albany, N. Y. ... 683
Maryland Meter and Manufacturing Co., Baltimore, Md ... 663
Jones Meter and Stove Co., Royersford, Pa ... 682
Chicago Gas Stove Company, Chicago, Ills ... 666

STREET LAMPS.

J. G. Miner, Morrisania, New York City ... 629
Bartlett Street Lamp Man'fg Co., New York City ... 665

BURNERS.

C. A. Gefroror, Phila., Pa ... 680
Moses G. Wilder, Phila., Pa ... 665

STEAM BLOWER FOR BURNING BREESE.

H. E. Parson, New York City ... 664

PURIFYING MATERIAL.

Connelly & Co., New York City ... 671
Friedrich Lux, London, England ... 666
Hill Chemical Company, Brooklyn, N. Y. ... 663

COKE CRUSHER.

C. M. Keller, Columbus, Ind ... 681

ELECTRICAL APPARATUS.

Wm. Henry White, N. Y. City ... 679
Fort Wayne Electric Co., Fort Wayne, Ind ... 672

BOOKS, ETC.

1890. Directory. 1890 ... 671
King's Treatise ... 673
Practical Electric Lighting ... 671
Electric Light Primer ... 671
American Gas Engineer and Superintendents' Handbook ... 675
Digest of Gas Law ... 663
Fuel and its Applications ... 664
Newbigging's Handbook ... 675

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WANTED.

Address, giving full particulars as to price, locality, thickness of coal, and whether operating at present,

805-1 "L. D." care this Journal.

SITUATION WANTED

As Superintendent of Gas Works,

By a man of excellent charac'er, and who can furnish the best of references. Thoroughly understands the manufacture and distribution of coal and water gas, and the construction of works. 805-3 Address "R.," care this Journal.

Position Wanted

As Superintendent of Gas Works.

Has had a large experience in the manufacture and distribution of gas and construction and extension of gas plants. A1 references. Address

803-tf "E.," care this Journal.

Coal Tar For Sale.

PROPOSALS for the entire make of Tar in the works of the **Pittsburgh Gas Company,** for five (5) years from the 1st day of January next, will be received at their Office, No. 77 Sixth Avenue, Pittsburgh, Pa., until the 13th day of December next, at noon.

Bids to be by the net ton (of 2,000 pounds) of coal carbonized. Tar to be delivered in tar tank at works. Right to use sufficient tar for Company's own purposes, and to reject any or all bids, reserved.

804-6 JOHN H. McELROY, Engineer.

Dissolution of Partnership.

HENRY J. DAVISON & COMPANY.

Notice is hereby given to all interested parties that the co-partnership existing between Henry J. Davison and Frank F. Jones, under the firm name of Henry J. Davison & Company, was dissolved on the 22d day of July, 1890, by the death of the said Davison.

The affairs of the firm will be liquidated by the surviving partner, Frank F. Jones, at his Office, No. 2 Wall Street, N. Y. City, where all claims must be presented on or before Dec. 31, 1890.

DURAND WOODMAN, Ph.D.,

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FOR SALE,

The Ironwork for Ten Benches of Fives (5's).

Cast iron Hydraulic Main, 16 by 18 in. Stand Pipes, 5 in. at bottom, 4 in. at top. Bridge and Dip Pipes, 4 in. Address

DAYTON GAS LIGHT AND COKE CO.,

783-tf 120 East Third Street, Dayton, Ohio.

The American Gas, Light & Heat Co.,

OF

249 S. 6th St., Phila., Pa.,

Are now prepared to erect plants of their Oxy-Hydrocarbon Process, to carburet coal gas up to any given or named candle power required for general consumption (for instance, from 20 to 25 candles), and at a cost not to exceed one and three-quarters (1¾) cents per candle power per 1,000 cubic feet increased, with a permanent and perfectly *fixed* gas, *not a vapor*—a gas tha will whiten the whole output of the works.

This gas can be furnished at a cost less per 1,000 cubic feet than the coal gas may be costing the company.

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This is much less per candle power than it can be furnished by the use of cannel coal or by vaporizing naphtha. With our process we improve the whole output in color—viz., whiten the flame with the oxygen, as well as furnishing a *thoroughly fixed* gas, and no possible danger of separation as there is with vapor.

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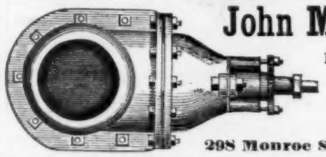

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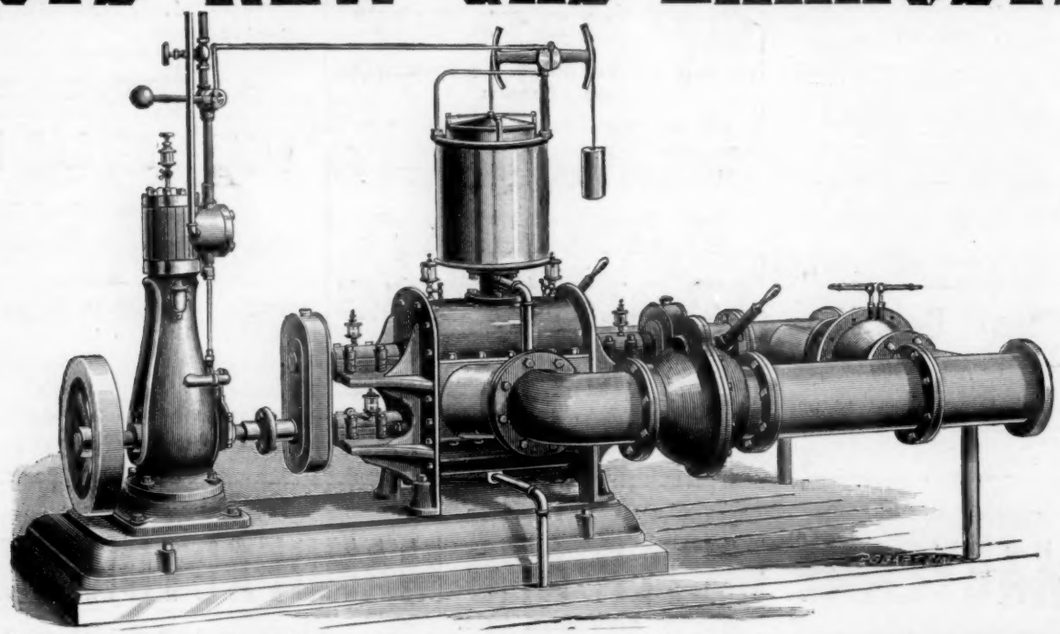

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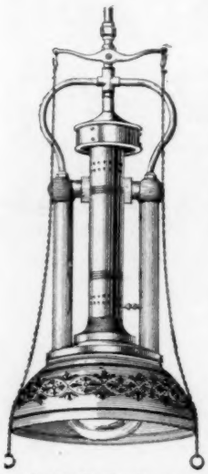

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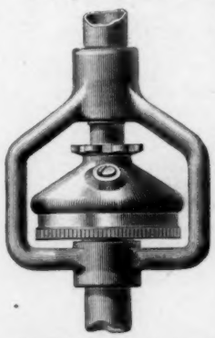

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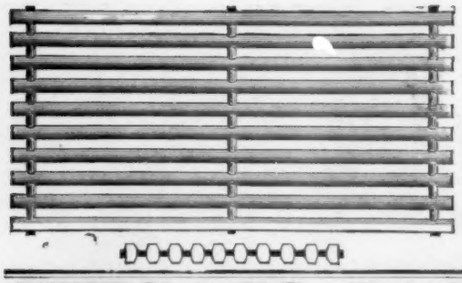

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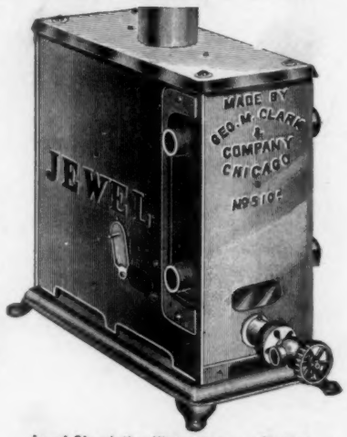

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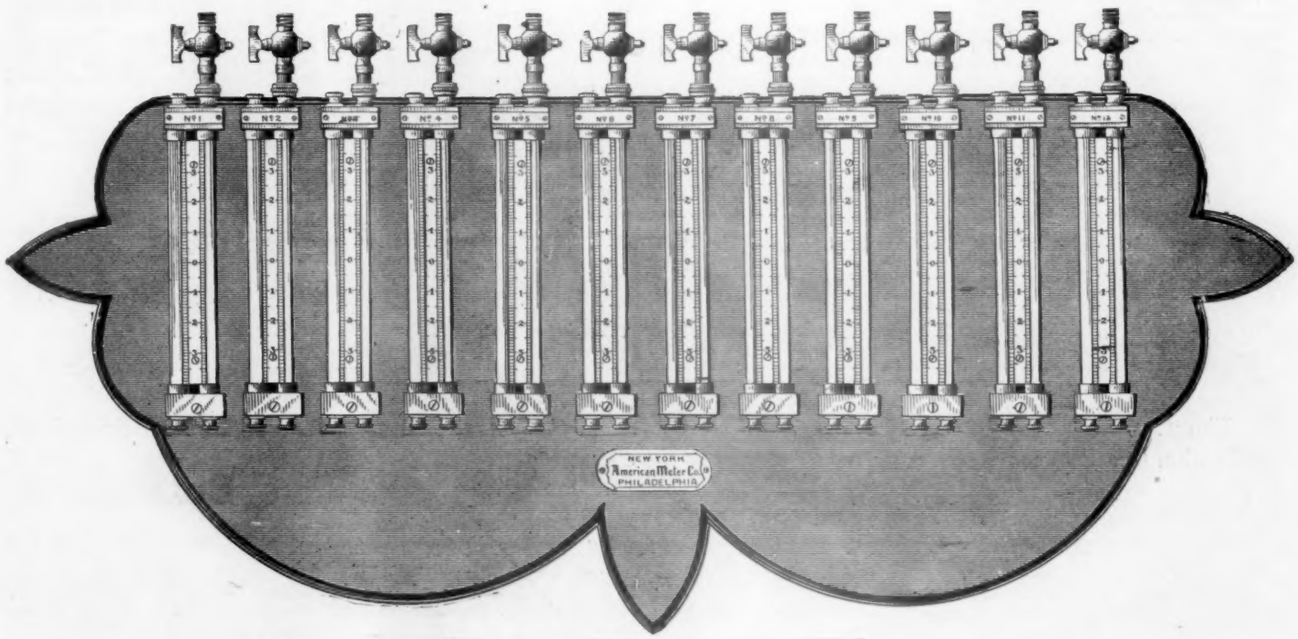

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I am yours truly, (Signed) G. C. TREWBY.

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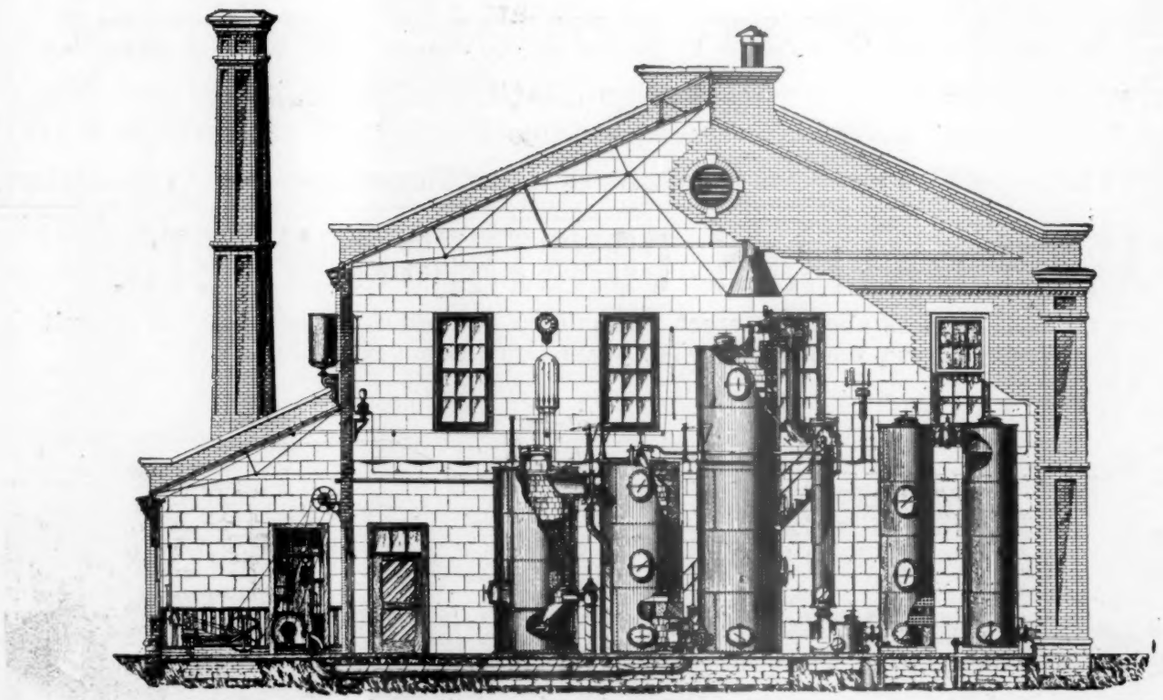

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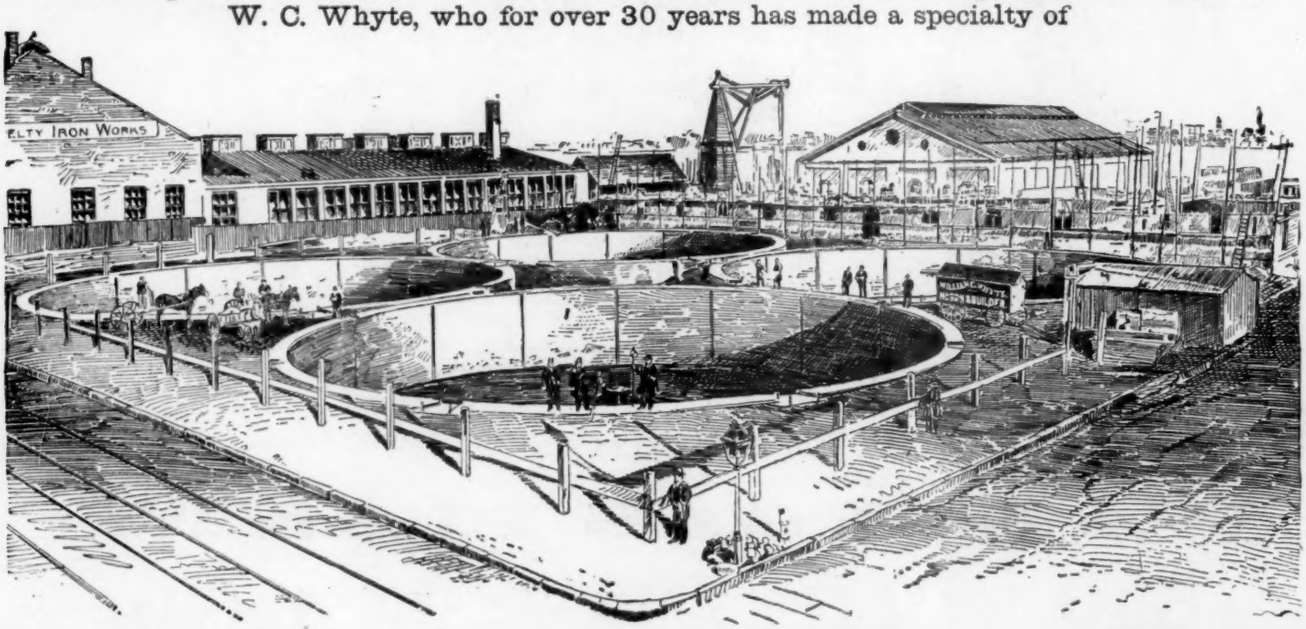

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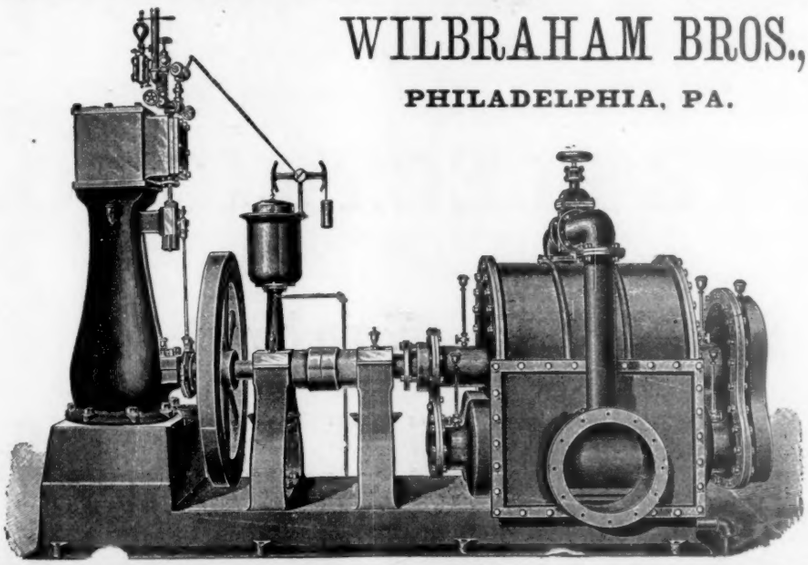

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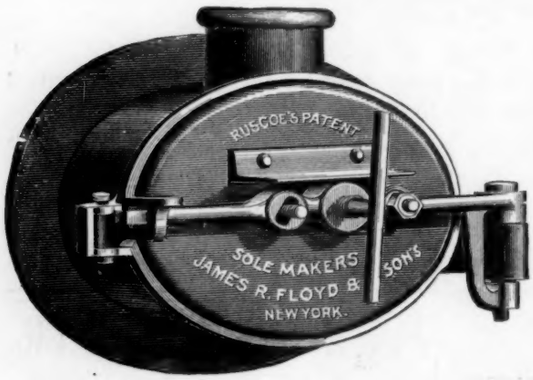

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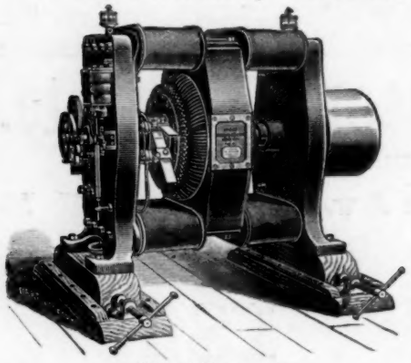

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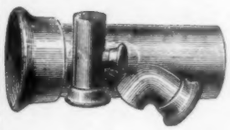

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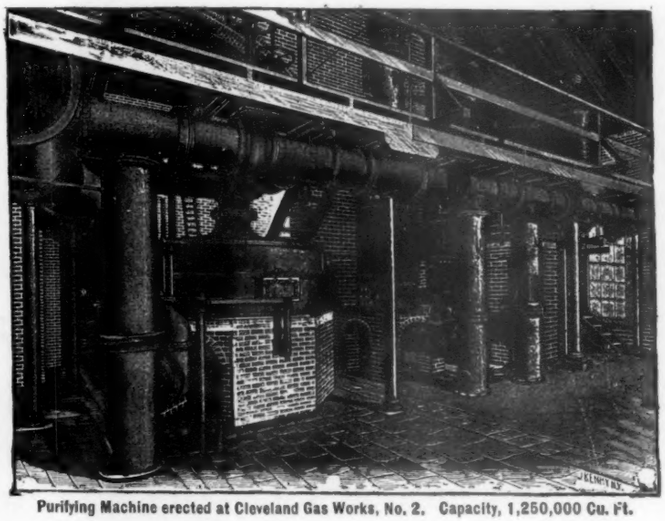

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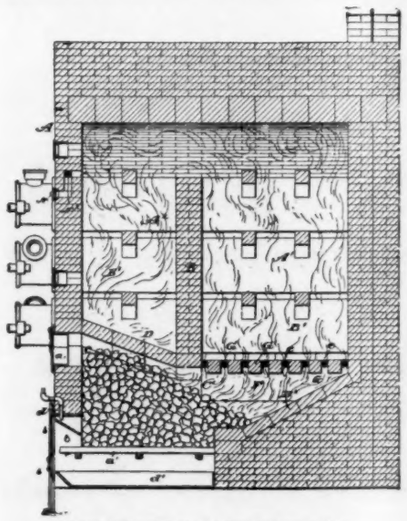

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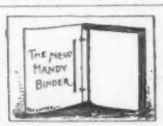

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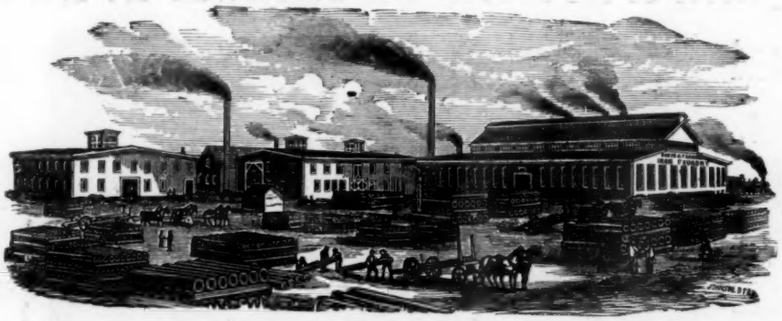

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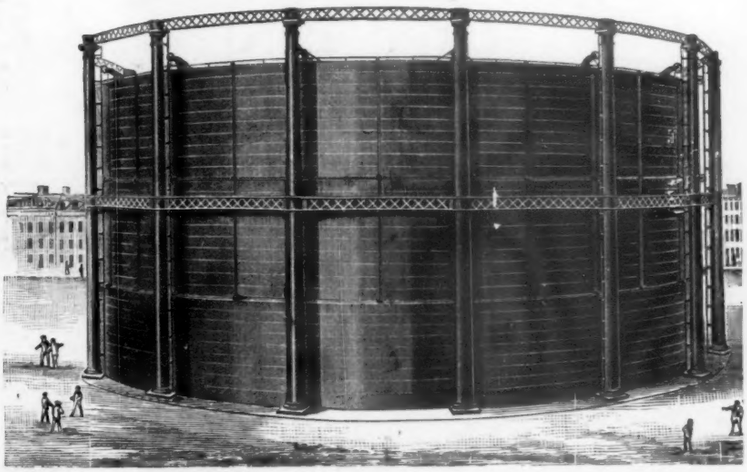

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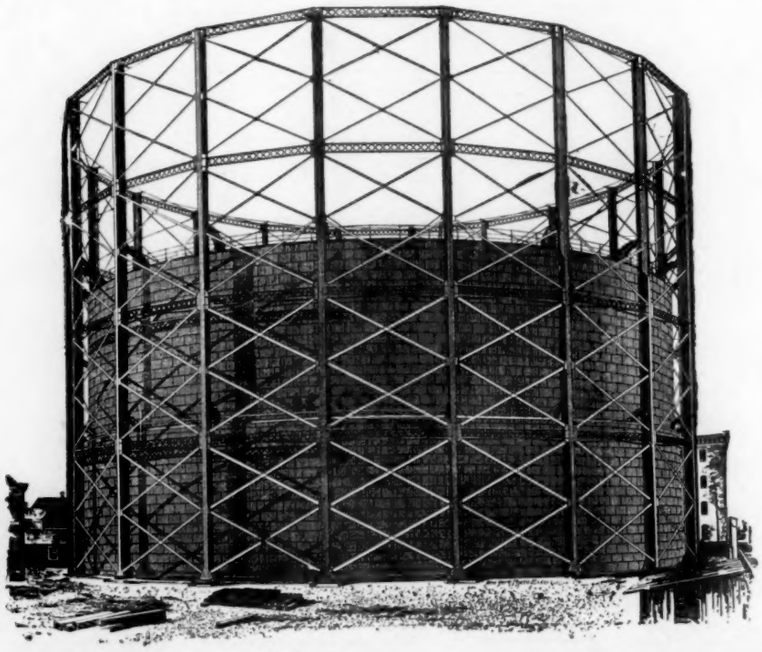

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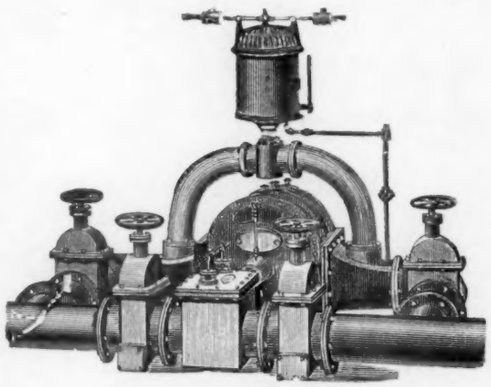

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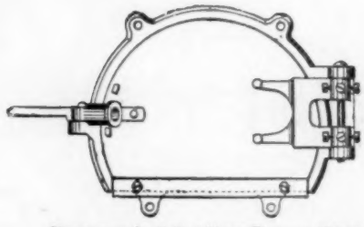

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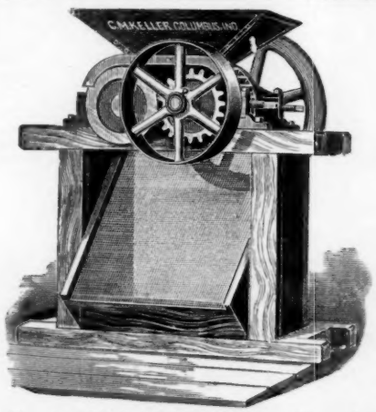

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The utility and convenience of the Gas Engine being no longer an open question, it only remains now for intending purchasers to select the BEST. We claim for the CLERK GAS ENGINE that it is equal to any other manufactured as regards steadiness in runn ng, simplicity, and ease of keeping in repair, and that it gives the greatest amount of power for the least money (both in first cost and expense of running) of any engine made. In support of this claim we refer to the test of the Gas Engines made under the direction of the American Institute of New York, in December, 1885, and heretofore published in these columns. These engines are especially adapted for continuous running under heavy loads, and we can refer to Engines which have run 22 hours a day for months at a time

Made in Sizes of 5, 10, 15, 20, and 25 Horse Power. All Engines Guaranteed for One Year.

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Careful and Prompt Attention paid to Repairing of all kinds of Meters and Apparatus.

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With 40 years' experience and the best facilities for manufacturing, is enabled to furnish reliable work and answer orders promptly.

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Meter Provers, Pressure Gauges, and All Other Gas Appliances in Our Line.

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High Pressure Meters for Natural Gas, in Iron Cases, guaranteed to stand 300 lbs. Pressure. Gas Cooking and Heating Stoves, Hot Plates, Cake Griddles, Waffle Bakers, Boiling Stoves, Laundry and Tailors' Iron Heaters. Hotel and Cafe Ranges a Specialty.

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Center Seals, Pressure Registers, Governors, Indicators, Photometers, and all other kinds of Apparatus for use in Gas Works.

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Station Meters (square, cylindrical, or in staves), Glazed Meters, King's and Sugg's Experimental Meters, Lamp Post Meters, etc., etc. Meter Provers (sizes 2, 5, and 10 feet), Pressure Gauges of all kinds, Pressure Registers, Pressure and Vacuum Registers, Pressure Indicators (sizes 4, 6, and 9 inch), King's Pressure and Vacuum Gauges, Dry and Wet Center Seals, Dry and Wet Governors, Exhauster Governors, Photometers of all descriptions. Letheby's Sulphur and Ammonia Test Apparatus complete. Also, Testing and Chemical Apparatus of all kinds, and of the most perfect description, for all purposes relating to Gas.

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STATION METERS, EXPERIMENTAL METERS, METER PROVERS, PRESSURE & VACUUM REGISTERS, PRESSURE GAUGES, ETC.

Also STAR GAS STOVES, RANGES, and HEATING STOVES.

We use only the very best materials, and employ the most skilled labor, and by our long experience (36 years) and personal supervision of every detail, we feel justified in assuring the public that our goods will give perfect satisfaction. Every Meter emanating from our establishment will bear the State Inspector's Badge, and will be fully warranted by us. Our Annual and Calendar will be sent to Gas Companies upon application.

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SOLE MANUFACTURERS OF THE

"SUN DIAL" GAS STOVES,

The Most Economical, Efficient, and Durable Gas Stove Made.

GAS COOKING STOVE, No. 8 C.

SIZE.

Stove.	Oven.	Roaster.	Top.	Length over Extension Shelves,
37 in. high.	12 in. high.	12 in. high.	24 in. long.	36 in.
20 in. wide.	17½ in. wide.	18 in. wide.	21 in. wide.	
	12 in. deep.	13 in. deep.		

This Stove has four burners on top, and double oven burner.

Consumption of gas with all burners in use, 42 feet per hour, at 1 inch pressure.

The top is made in sections, so that a greater variety of cooking utensils may be used. By lifting out the covers and crosspieces and putting in a suitable forked ring, which is sent with each stove, a wash boiler or other large utensil may be set over two burners. Our **No. 87 GRIDDLE** also fits in the same position. The roasting oven is provided with a cast-iron door.

All Fittings are Nickel-Plated.

GAS COOKING STOVE, No. 7 B.

SIZE.

Stove.	Oven.	Roaster.	Top.	Length over Extension Shelves,
31 in. high.	9½ in. high.	10 in. high.	21 in. long.	32 in.
17 in. wide.	14½ in. wide.	15 in. wide.	16 in. wide.	
	12 in. deep.	13 in. deep		

This Stove has three boiling burners in the Top or Hot Plate, and one single oven burner.

This cut represents our New Style Cooking Stove. As will be seen, it has an ornamented cast-iron Base and Front, and extension shelves. The Oven Burner, which is atmospheric (unless otherwise ordered), is of an entirely new and improved pattern (patent). The ovens are of greater capacity than those of the old style. The Top, in conjunction with the Outlet Pipe, is designed to carry off all the products of combustion, if desired, but they are also supplied with a loose ring which converts it into an ordinary open top stove.

The consumption of this Stove is 35 cubic feet per hour at 1 inch pressure, with all Burners in use.

All Fittings are Nickel-Plated.

"RADIANT" BOILING STOVE, WITH REGENERATIVE BURNER.

Size, 6¼ inches diameter, 3 inches high. Consumption, 6 feet per hour at 1 in. pressure.

HOT PLATE, No. 111.

Size, 36 in. long, 12 in. wide, with three double burners, 6 taps.

Consumption, with all burners in use, 36 cubic feet per hour, with 1 in. pressure.

¾ in. supply pipe should be used where the pressure is 1 in. or over.